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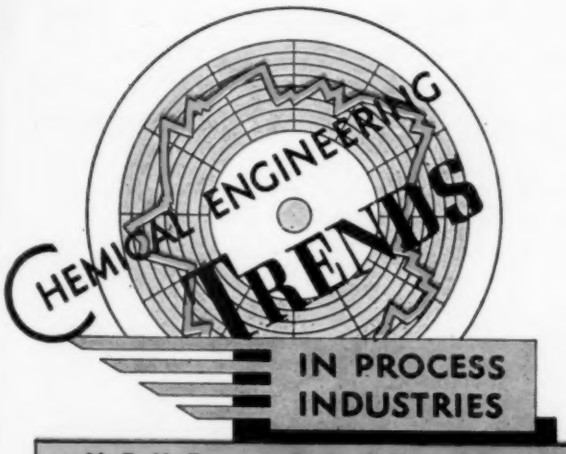

CONTENTS FOR VOL. 44, NO. 1

JANUARY, 1937

As the Profession Moves Into 1937 1
An Editorial

Trends in the Pulp Industry 4
By Harold R. Murdock

Paper Making Undergoes Many Changes 9
By Clark C. Heritage

Geared Centrifugals Speed Up Sugar Refining 14
By Daniel Gutleben

Trends in Organic Chemicals from Petroleum and Natural Gas 18
By Benjamin T. Brooks

Textiles Await Improvement of Many Unit Operations 22
By Winn W. Chase

Economic and Engineering Trends in Plastics 25
By Alan F. Randolph

Recent Developments in Pressure Industries 29
By Norman W. Krase

Superphosphate Process Made Continuous 30

A New Raw Material—Ethyl Cellulose 31
By J. M. De Bell

Phenolate Process for Removal of Hydrogen Sulphide from Gas 33

Extraction and Absorption Discussed at Columbia 34
Editorial Staff Report

Large Increase in World Production of Arsenic 56

NEXT MONTH—14th ANNUAL REVIEW NUMBER

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CHEMICAL & METALLURGICAL ENGINEERING

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S. D. KIRKPATRICK, Editor

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JANUARY, 1937

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AS THE PROFESSION MOVES INTO 1937

IT IS BECOMING INCREASINGLY EVIDENT that chemical engineering has broadened its base to include many activities once far removed from those of major concern to the technologist. Today the chemical engineer faces new responsibilities of social as well as of technical and economic significance. His work will call for a high order of industrial statesmanship as he tackles the many problems of the new year.

Labor relations loom largest on the industrial horizon, but they are not alone among the chemical engineer's problems. Legislative matters affecting costs of raw materials and pricing of finished products, international trade, patents, stream pollution and a score of other issues add to the burden of executive responsibilities. And on the professional side are the problems of guiding and developing those who are to carry on the work of the future. The task is not an easy one but it promises to be interesting and remunerative for those who will accept its important responsibilities.

Three decades of progress in the process industries of America have served to emphasize the changing character of the chemical engineer's contribution. The World War decade provided the greatest opportunity for technical advance as new industries were being developed to meet our mounting requirements for essential chemicals, medicinals and munitions. The groundwork was laid for carrying forward and capitalizing on the achievements of improved technology. Then came the great economic decade of the twenties. During that period chemical industry learned its lesson in self analysis—in tailoring its goods to fit the changing pattern of business conditions. It was this progress in economic planning in the twenties, supplemented by creative technology, that made possible the industry's remarkable stability during the distressing years of the depression.

When history records the story of the thirties, it will be evident that the decade now more than half over has contributed a third basis of support, namely, sound social relationships. We are in the midst of a social revolution and readjustment quite as fundamental and perhaps more important than the work of either of the two preceding decades. During the next few years, those process industries which are to survive and prosper will probably give almost as much attention to social questions as to those of technology and economics.

Social questions, unfortunately, are often more difficult to answer than either technical or economic issues. Technology may be subjected to accurate quantitative analysis. Economic questions are at least quasi-quantitative and are rapidly becoming susceptible of accurate analysis and adjustment. But social problems are

rarely submitted even to crude qualitative analysis. Decisions are usually made on an emotional basis. Some of this is inevitable, of course, but the chemical engineer can doubtless help in bringing about a more orderly and accurate treatment of social problems. And the right answer is ineffective unless accompanied by a certain amount of persuasiveness and conviction which it behooves the chemical engineer to study and acquire.

Employment and Unemployment

NO INDUSTRY IS IMMUNE from labor problems as the recently serious situation in automotive factories proved only too well. Despite the fact that chemical plants have paid higher than average wages for fewer hours of work, and have provided steadier employment for an increasing number of workers, there are those who profit by stirring up strife and discontent. For the chemical engineer and executive to meet such situations fairly and firmly calls not only for right methods but real ability and persuasiveness in their application.

Present and prospective legislation affecting labor problems centers principally in Washington. There a group of conflicting interests struggle mightily in the hopes of bringing about a sounder system of human relations. Whether the results achieved are good or bad is an open question but the situation bears careful watching. An interpretation of the more pressing of these labor problems will be found in the Washington news pages of this issue.

One costly lesson, not to be forgotten, is that unemployment is a burden to be shared by all in the chemical profession. What was accomplished by local groups of chemists and chemical engineers did much to maintain morale and encourage and promote adjustment and re-employment. Better business has lifted much of the burden, but let us not abandon any constructive efforts that are still effective in placing men in proper jobs—especially the older men who are fighting hardest to get back their places in the profession.

Problems of the Older Employee

ECONOMIC SECURITY has always been sought by the individual. Now even the improvident have been convinced that they are entitled to some such rights from society as a whole. The issue is apparently no longer debatable, but the mere acceptance of the principle is but a small step toward the solution of the problem which the professional man must solve in part for the older employee. The process industries will take full advantage of the benefits which can be derived from unemployment and old-age protection in the federal and state laws, but it does not seem wise nor fair to present employees to abandon the pioneer work that many companies have done in developing sound pension and retirement plans. At some future date, after grievous struggle and painful experience, we may get a fully effective and properly managed program for social security. In the meantime, those private annuity and security plans that have proved sound must make up for the deficiencies of the present public effort.

The cost of caring for idle or retired personnel may be serious, but it is a cost which industry must assume. The problem is how this can be done with a minimum burden on the goods or the services to be sold. In the process industries one of the tasks of the chemical engineer will be to fit these new social obligations into his production costs—definitely an engineering responsibility.

What About the Younger Man?

EACH YEAR IN INCREASING NUMBERS, a great many young men are presenting themselves at our educational institutions asking to be trained in chemical engineering. No more important task confronts those of us older in this profession than the aiding of these younger men. Some should be guided out of chemical engineering as temperamentally or by limited capacity unsuited for so arduous a course. Others should be directed toward thorough graduate training in institutions of high standing. All should have the benefit of more frequent and intimate contact with chemical engineers in industry.

The fine work of the Engineers' Council for Professional Development and that of the education and student chapter committees of the American Institute of Chemical Engineers is already exerting an important influence on the education and development of those who are to carry on the work of the profession. To this, more personal effort by individual engineers might well be added.

But by far the most serious gap in the present program of our profession has to do with post-college education and development. Little or no organized effort is being made to stimulate the young chemical engineer in a program of professional development. This is a responsibility which the industrial executive must share with the professional society. Every enterprise of magnitude can well afford to provide opportunity and incentive for these younger men, and some not so young, to continue systematic reading, study and conference for individual advancement. Smaller enterprises might collaborate with each other or with nearby educational institutions. The stimulus of continuing study is the greatest insurance against laggard business thinking that can be bought anywhere. And the cost is negligible as compared with the advantages.

Those who have not had the opportunity for formal schooling beyond grade or high school should be given equal consideration. Every promising worker, whether paid by hour or week, should be encouraged to advance his knowledge of the business and to try for a post of greater responsibility. Such flow upward of talent will do much to staff the higher positions with capable men. The man who is striving for a better job is not a trouble-maker. He not only takes care of himself, but he stimulates the progress of his less promising co-workers.

Research Is an Investment

NO EXPENDITURE OF PROCESS INDUSTRIES takes on more clearly the aspect of prudent investment than do the disbursements made for research and development work. It is expected that the chemical manufacturers of America alone will spend during 1937 over $20,000,000 on such activities. Other process industries, such as soap, petroleum, paper, paint, rubber, and glass will also disburse large sums, probably in the aggregate a total of $50,000,000.

This effort of the process industries is not new. Indeed many of our newer chemical and process industries would not have come into being without such research disbursement in the past two decades. The social implications are even more significant than the technical and economic consequences.

These disbursements in research create industry. They pave the way for huge additional expenditures for new plants and machinery to house and mechanize the research results. They provide new opportunities for employment; they absorb new raw materials; they give new products for social services and they lower the cost of goods so that all may buy more cheaply than heretofore.

If one were able to rank the various process industries in the order of their research disbursements, he would probably find that the same ranking would apply to their progressiveness, financial stability and to their public acceptance. Chemical engineers are therefore contributing handsomely to social advance when they plan, carry on, and put into plant practice the results of scientific and engineering research. This is one of their prime responsibilities in industry.

Public Relations Problems

SOLVING PROBLEMS IN PUBLIC-RELATIONS often demands more knowledge of psychology than of technology. Only in exceptional instances is a chemical engineer assigned to study these matters for his employer. But, even so, no professional man has any right to be unmindful of them. What the other fellow thinks about your process, your product, your company, has become so vital a matter that every employee of the enterprise should be concerned with these matters.

It is a professional habit of chemical engineers to make critical studies even of their own pet processes and products. Without such harsh review, one may not keep abreast of advancing industry. It seems logical, therefore, that each member of the profession should make as keen and critical a test of the public relations of the enterprise with which he has to do as of its methods, materials and machinery.

And chemical industry as a whole has a like responsibility. Too many people fail to appreciate the importance of the chemical contribution to their comfort, convenience and daily necessities. Too many still associate chemical industry with war and destruction. It is time to begin thinking about a broad industry program of public education.

Finally, Profits and Progress

INDUSTRY EXISTS FOR THE PURPOSE of rendering a service, with the reward of wages for those who work and profits for those who plan and who risk investment in the business. Generally speaking, the public does not resent the enterprise which makes large profits. Some of the industrial leaders who have become most wealthy are not subject to general public criticism. The difference seems to be largely a question of the public's appraisal of the value of the service rendered to it while the profit is being earned. With this in mind, chemical engineers and executives may wish to talk more about the public services rendered through their industrial efforts. Even when somewhat distasteful to the individuals or companies involved, it may be desirable that the public should be told about the service value of chemical engineering enterprise.

Most direct and stimulating progress will continue to result from the sound application of chemical engineering in industry. Hence in this January, 1937, issue of *Chem. & Met.*, the editors have attempted to reflect the more important chemical engineering trends in some of the industrial fields that have been most active during the past few years. In February, this present effort will be supplemented by a comprehensive survey of economic trends, particularly as they affect chemical raw materials of process industries. So as *Chem. & Met.* moves with the profession into 1937, it will be with an earnest effort to keep in mind the technical and economic and—last but not of least importance—the increasing social responsibilities of chemical engineering.

Sidney D. Kirkpatrick

Volume 44—**Chemical & Metallurgical Engineering**—Number 1

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death on Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and was succeeded in the editorship by Sidney D. Kirkpatrick.

The editorial staff of the magazine comprises: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor and Robert L. Taylor, assistant editor. R. S. McBride and Paul D. V. Manning are editorial representatives in Washington, D. C., and on the Pacific Coast, respectively. [All rights to above magazine titles are reserved by the McGraw-Hill Publishing Co.]

Houston, Tex., bleached kraft mill of Champion Paper & Fibre Co. This is one of the many mills under construction in the South at present

Trends in WOOD PULP INDUSTRY

THE DEPRESSION was a blessing in disguise for the wood pulp industry. It brought about a strong buyers' market which created specifications that taxed the ingenuity of the pulp producer. As usual, necessity became the mother of invention and substantial improvements in quality and production costs resulted. When stronger pulps were demanded, the industry found the way and when whiter pulps were imperative, the industry called upon its technical departments, as well as those of the equipment industries, and met the challenge.

The rayon industry also has contributed to this progress. That wood pulp could be used to advantage in the rayon industry was the hope of many wood pulp producers. Mills were erected for the specific purpose of making rayon pulps, particularly on the Pacific Coast. They had a new point of view, modern equipment to use, and a meticulous industry to serve. They abandoned old ideas and practices of the paper pulp producer and started down a new road for a new objective. Rayon pulps found their market but at first the papermakers showed little interest in them. Such pulps handled differently. They were purer and required more working in the beaters and jordans than the paper-maker was used to doing. However, they possessed an inherently stronger physical characteristic, so when the demand for stronger pulps arose in the paper industry they were accepted as a new paper-making material.

With such recognition for these pulps, the mills producing paper-making pulps investigated the processes of the rayon pulp manufacturer. While they found therein the salient features of their own operations, they also found better standards of control, better details in processing, particularly in bleaching, and in many places a complete disregard of tenets which had heretofore been considered axiomatic. The aggressive pulp mills soon incorporated many of these good points found in the rayon pulp mills with considerable advantage to their own operations. This proceeded to such a degree in some mills which had sold paper-making pulps, that they attempted to enter the rayon field. However, they soon realized that their equipment was not capable of meeting the vigorous specifications of rayon pulps. Nevertheless, the wood pulp industry received a definite impetus due to the rayon pulp demands.

Another incentive responsible for the progress made in the wood pulp industry is the increasing demand for the product. Wood pulp uses have continually expanded and the importation of pulps has increased at even a faster rate. Importations amount to over 40 per cent of the United States pulp consumption. These importations show a surprising increase in both unbleached and bleached sulphate pulps. Recent expansion in the South, where six new sulphate mills are in process of erection, therefore, appears justified. However, this expansion has about caught up the slack and any further expansion at this time is not warranted. The South has been producing strong kraft pulps from Southern pines for over 15 years, and at least one mill has developed processes for making bleached pulps from this pine and has operated so for over ten years in spite of recent propaganda that such possibilities had not already been enjoyed. The Pacific Coast has also taken part in an expansion program and the future of the industry, at least from the point of wood supply, seems likely to be concentrated in these two areas.

These three major conditions, namely, the depression

By HAROLD R. MURDOCK
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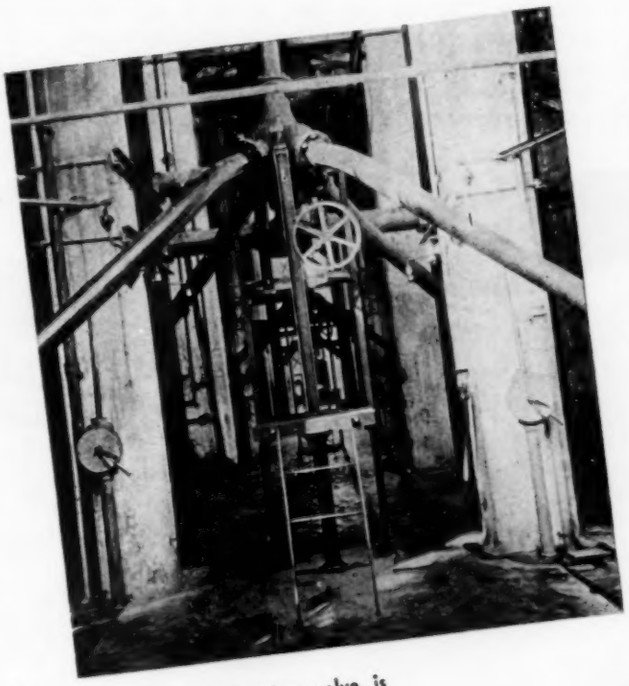


A new multiple blow valve is becoming popular in the kraft industry

era with its buyers' market, the demand of the rayon industry, and the statistical position of wood pulp, have given the industry a healthy stimulus to forge ahead. Technical developments are being advanced from all quarters and this paper will discuss some of the more outstanding cases.

Inasmuch as the process of manufacture of groundwood pulp is entirely mechanical, developments have been of a mechanical nature, pertaining essentially to the grinder itself. Magazine grinders which automatically feed the wood to the grinder from the magazine hopper have been developed, but the most outstanding advancement has been the adoption of artificial grinder stones, in place of the natural sandstones which vary in hardness and density considerably.

Artificial stones are made either from alundum, or from silicon carbide. Recent observations indicate a preference for the latter because they do not expand as rapidly with changes of temperature incurred during grinding. The coefficient of expansion of silicon carbide is 50 per cent less than the alundum stone, so that the intensity of stresses in the several segments from which the stone is assembled is not as great from the heat produced in grinding. Then again, silicon carbide grains fracture easily so that the process of applying the cutting face to the stone with a burr is more readily accomplished than with other stones. The stone holds its cutting edge longer so does not require dressing as often and consequently the stone is of longer life than the natural stones. This compensates for the initial higher cost of artificial stones.

Temperature and pressure controls, and controlled means for applying the cutting pattern to the stone by means of burrs, has contributed to the progress. Then the empirical test of examining the pulp on a blue glass, which depended on the operator's eye, has given way to a numerically expressed scientific fiber analysis made by screen classification. The operator can now with these tools produce any type of groundwood he chooses with reasonable accuracy. He can also control the freeness or ability of the pulp to filter easily from water. Further, the use of bleaching agents such as zinc hydrosulphite has permitted a reasonable control of the color of groundwood pulp.

In the manufacture of chemical pulps it is imperative that the selection of wood and its quality be controlled. Five years ago it was generally considered absolutely essential that in order to make a rayon pulp, spruce wood coming from Canadian forests should be used. Now, however, the Western hemlock finds its market in the rayon industry and even the Southern pines which were once considered entirely unsuitable have been processed satisfactorily for rayon consumption. The wood must first be converted to chips. Mechanical devices for preparing the wood free of bark and knots have assisted greatly the production of clean pulps. The chipper also is recognized as important equipment in the control of quality. The angle and design of the spout are important in the elimination of slivers and dust. Chippers with 10 ft. disks have been constructed but a 6 ft. disk is considered an average size.

Three developments stand out as leading events in the progress of the sulphite process, namely, improved methods for burning sulphur and preparing the cooking liquor, the adoption of corrosion-resistant metals which permitted the indirect heating and positive circulation of liquor within the digester, and thirdly, the preheating and fortifying of the liquor with relief gases before introducing the cooking solution into the digester.

Earlier units have used the Glens Falls rotary sulphur burners, but with the adoption by contact sulphuric acid plants of the spray type burner and furnace for burning sulphur, use of this type soon followed in sulphite pulp mills. Advantages of this spray burner are deep rooted. The pulp industry wants a gas strength of 18 per cent SO_2, which this burner can easily supply. Then in case of lower or greater demand for gas, the quantity can be controlled conveniently by changing the speed of the centrifugal pump which operates by steam in the molten feed tank. In case of trouble in the absorbing system,

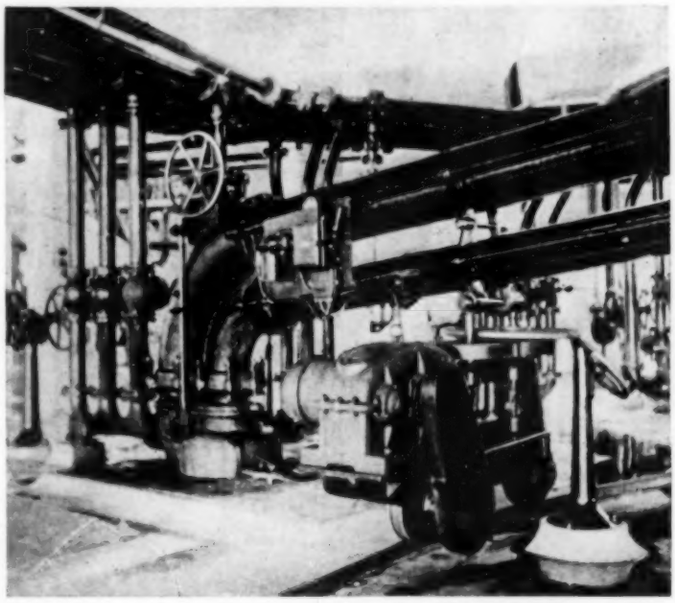
the gas supply can be cut off promptly. By use of high pressure blowers, the gas can be delivered at any pressure. This adapts the burner conveniently to pressure absorption systems, which are becoming more and more desirable in order to obtain a high concentration cooking liquor.

Stainless steels have made possible the other two features which have been outstanding developments in the sulphite process. Heretofore valves have been made from acid-resisting bronzes, and pipes were made of bronze, or hard lead. Where more severe corrosion occurs because of heat, the tellurium-antimonial lead has found satisfaction. But with lead it was not possible to construct equipment for the indirect heating of the cooking liquor and stainless steels came into extended use. For casting, the most useful alloy has been found to contain about 28 per cent chromium and 10 per cent nickel with usually 3 per cent molybdenum, according to J. D. Miller. The 20 per cent chromium, 10 per cent nickel and 3 per cent molybdenum is also reported as suitable. In the wrought form the best all round material is the 18 per cent chromium, 8 per cent nickel and 3 per cent molybdenum. An alloy containing about 27 per cent chromium, 4½ per cent nickel and 1½ per cent molybdenum is coming into use, especially for piping, because of the difficulty in obtaining seamless tubing from the former alloy.

By using these alloys it is possible to circulate the cooking liquor from the top of the digester through a pump and an external tubular heater and return this heated liquor to the bottom of the digester. By such practice we avoid dilution of the cooking liquor with the condensate, which occurs in direct heating systems and a more positive control on the distribution of the heat throughout the digester is made possible.

Many informed persons consider the so-called hot acid recovery system to be the foremost contribution to the sulphite process in recent years. Over 50 installations have been made so far. This would not have been possible without stainless steels. The recovery process is essentially a means for heating the cooking liquor and for fortifying it with sulphur dioxide before the cooking acid is delivered to the several digesters at the start of each cook. The relatively weak acid from the adsorption system is pumped to an accumulator, which is usually a globe-shaped vessel capable of withstanding digester pressures. The digesters under pressure are relieved of the noncondensible gases, such as air, from the chips, and of the excess cooking liquor which is used in the early stage of the cook in order to completely cover the chips and prevent burning. These reliefs are made to the liquor in the accumulator. This operation reclaims the heat in these relief gases and scrubs the sulphur dioxide from the gas, and thereby fortifies the cooking liquor for the start of another digester. The noncondensible gases in the accumulator are relieved through an automatic relief valve to the acid-making plant in order to recover the sulphur dioxide present in them. In this manner the digesters receive a stronger and hotter cooking liquor than has been possible with other processes. This decreases the pulping time and increases the yield of pulp obtained from the digester. Definite savings in steam and sulphur usage are also possible according to the sponsors of the process.

The alkaline pulping processes, in so far as digestion of the chips is concerned, are quite comparable. While considerable attention has been given to the ratio of chips to cooking liquor, to chemical concentrations, and to other details of the cooking process, more attention has been devoted to the method of discharging the digester and to recovery of the heat from the blow or discharge.



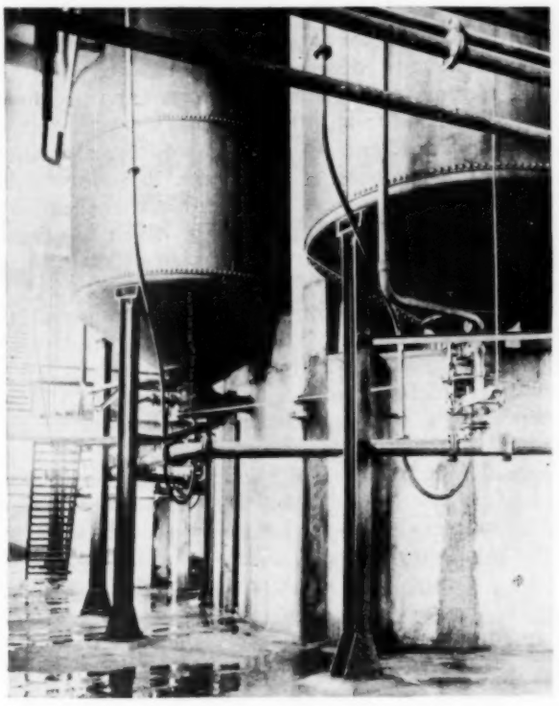
Digester contents are transferred without the troublesome features encountered in earlier designs with the help of a quick connecting coupling

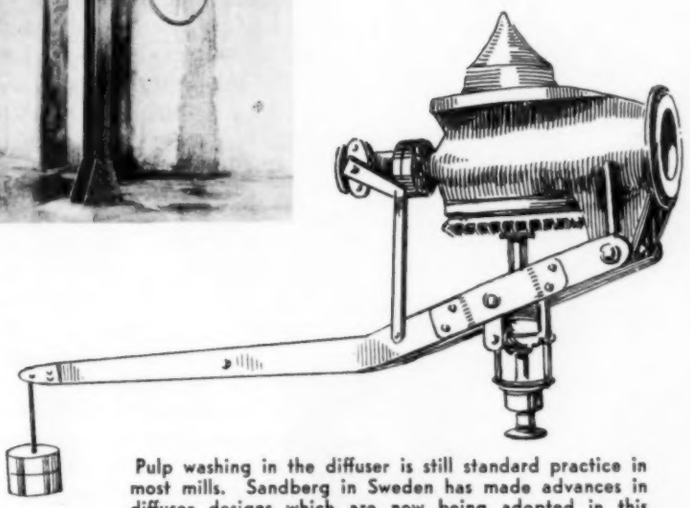
CHEMICAL ENGINEERING TRENDS IN PROCESS INDUSTRIES

Sandberg in Sweden has made advances in diffuser designs which are now being adopted in this country. A central valve connects the digester blow line to each of the digesters and through this valve the digester contents are blown into one of a series of diffusers. These tanks are accurately positioned to form a circle, the center point of which is a swivel joint to which the blow line connects. From this swivel joint the contents can pass through a swinging pipe line to any diffuser desired. By means of this motor driven, ball bearing swivel joint and a quick connecting coupling, the digester contents are transferred without the troublesome features encountered in earlier designs. The flash steam passes from the diffuser through another pipe line operating on the swivel joint and on into a cyclone trap placed above the swivel joint. When the blow is over, a valve at the bottom of the cyclone is opened and the pulp is washed into the same diffuser into which the digester was blown.

The steam passes on from the cyclone to a Rosenblad condensing unit, which is another important development in recovery of values from the digester. He designed a process in which the surge of steam at the blow is passed to a jet condenser. The water for the condenser is drawn from an accumulator tank into which, at the top, enters the hot condensate from the jet condenser. This large storage tank of hot water serves to hold the heat between the blows of the several digesters. The heat is withdrawn from this tank by means of a heat exchanger which takes the hot condensate from the top of the tank and returns it as cold condensate to the bottom part of the tank, where it is recycled to the jet condenser at another blow period.

By such means the intermittent heat from the blow is leveled out as clean hot water supply which can be used in the pulp washing steps. The steam from the blow carries over black liquors and foul odors which prohibit its direct use for water heating. The noncondensible gases from the blow pass with the steam into the accumulator tank and are vented from it into air lines by which they are carried to a stack or burned in the recovery plant units. With such a practice the odor characteristic of kraft mills can at least be kept under control.





Pulp washing in the diffuser is still standard practice in most mills. Sandberg's layout permits more ease in this operation than was possible heretofore. He installs a unique valve on the bottom of each diffuser.

Pulp washing in the diffuser is still standard practice in most mills. Sandberg's layout permits more ease in this operation than was possible heretofore. He installs a unique valve on the bottom of each diffuser. When the pulp is completely washed by the usual countercurrent passage of water through the battery of diffusers, water is then introduced at the lower portion of the diffuser to raise the pulp bed to the top of the diffuser so there will be no water pressing on the pulp during emptying. The water displaced from the top goes to a stock chest. The discharge valve is then opened by a handwheel on the operating floor and water is introduced into the valve through two apertures located beneath the valve disk. This construction prevents the passage of any water into the diffuser and diluting the black liquor when the valve is closed.

The valve stem is supported on a bearing and is actuated by a pair of levers connected to the operating gear on the operating floor. There is a sprocket on the valve cover which rotates the valve stem and disk slowly while the valve is open. With the valve stem rotating, the water passing through the apertures below the valve disk is, due to its high pressure, able to impinge on the pulp in the lower portion of the diffuser and readily wash it out into the stock chest.

Considerable advancement has been made in the filtering of black liquor, containing the spent cooking chemicals, from the pulp. Besides the above diffuser method there has been developed the use of vacuum filters. However, the last word in handling these solutions on vacuum filters has not been written. They are in a stage of further development and progress in handling foam producing filtrates can be expected. The diffuser method does not offer the same opportunity for technical advancement, and since vacuum filters require less investment than for diffusers and use much less floor space, it seems reasonable to expect an extensive use of vacuum filters in the future for washing unbleached pulps.

The direct use of chlorine in the bleaching of wood pulps has found commercial application only recently. Before this, all pulp bleaching was done with lime bleach. While it was recognized that the lime bleaching impaired the strength of the pulp, this condition was acceptable until the papermaker demanded pulps of higher whiteness and strength. To obtain this improvement, the pulp producer logically tried to use more lime bleach and while he obtained the desired whiteness, he unfortunately found that this treatment had seriously injured the quality of the pulp and it was unsuitable for use. Further studies showed that better results were obtained if the lime bleach was added to the pulp in portions, and if between each addition, the products of the reaction

were washed from the pulp before adding another lot of lime bleach. The more divisions or stages of treatment used, the better was the quality of the pulp obtained. But the improvement found in such multiple bleach stages was still below the quality desired and furthermore the equipment cost became prohibitive. It therefore appeared requisite that bleaching reagents other than lime bleach be investigated.

With a full realization of such a need, new bleaching processes originated in many quarters. At present the industry has no generally accepted process. Each mill has its own preferred practice and with a few exceptions the processes are based upon the use of chlorine water or chlorine gas in combination with lime bleach and other chemicals. These many processes will require time and experience before they can be expected to mature into generally accepted practice. Such a stage of transition is now in progress.

Chlorine is a corrosive chemical in the presence of water so that the perfection of materials for construction was a vital requisite to the modern bleaching process. Originally a wooden tower was used, but it had a short life. Wood has been replaced with many materials such as Haveg, Hastelloy, acid-proof tile, rubber and enameled steels. Even silver has been considered. No one material has been in use for a sufficiently long period to prove its superiority over any other.

In filtering the pulp from the spent bleaching solutions, rotary vacuum filters are used universally. In filtering the chlorinated pulp a different corrosion problem was encountered. The filtrate is weak hydrochloric acid and some excess chlorine carried through with the filtrate. Here again the entire gamut of materials of construction had to be considered and filters of many materials and designs were considered. At present a considerable number of rubber-covered steel filters are in use, and favorable results are reported from most users. The industry has bridged the period of anxiety, and while corrosion is still a problem in the bleaching process, a more staid and logical advancement appears probable.

A purified pulp might be described as one which has been freed of not only all foreign particles such as sand, carbon and incompletely liberated wood fibers, but one from which also has been removed all short weak fibers which do not contribute to the strength characteristics for which the pulp is designed. Foreign particles are best controlled by not permitting them to be introduced into the process. This means rigorous preparation of clean wood and the careful clarification of the cooking liquors. Even when this has been done the unbleached pulp must be screened through vibrating flat screen plates, in which are cut slots of a uniform size, and through which all accepted pulp fibers must pass. Flat screens for wood pulp have been greatly improved mechanically in their operation. Recently the adoption of chrome plated plates has resulted in a decreased rate of wear on the slots. The bundles of unliberated fibers from the pulping operation which cannot pass the slots wash down the battery of screen plates, and are removed and used for other less exacting purposes. In modern mills, particularly rayon pulp producers, the pulp is screened before and after bleaching. But frequently this is not sufficient. Rifflers in which the pulp is allowed to flow over felts and baffles, in a state of considerable dilution, have proven effective in removing the slime and resinous components. This operation adds decidedly to the brilliance of pulp.

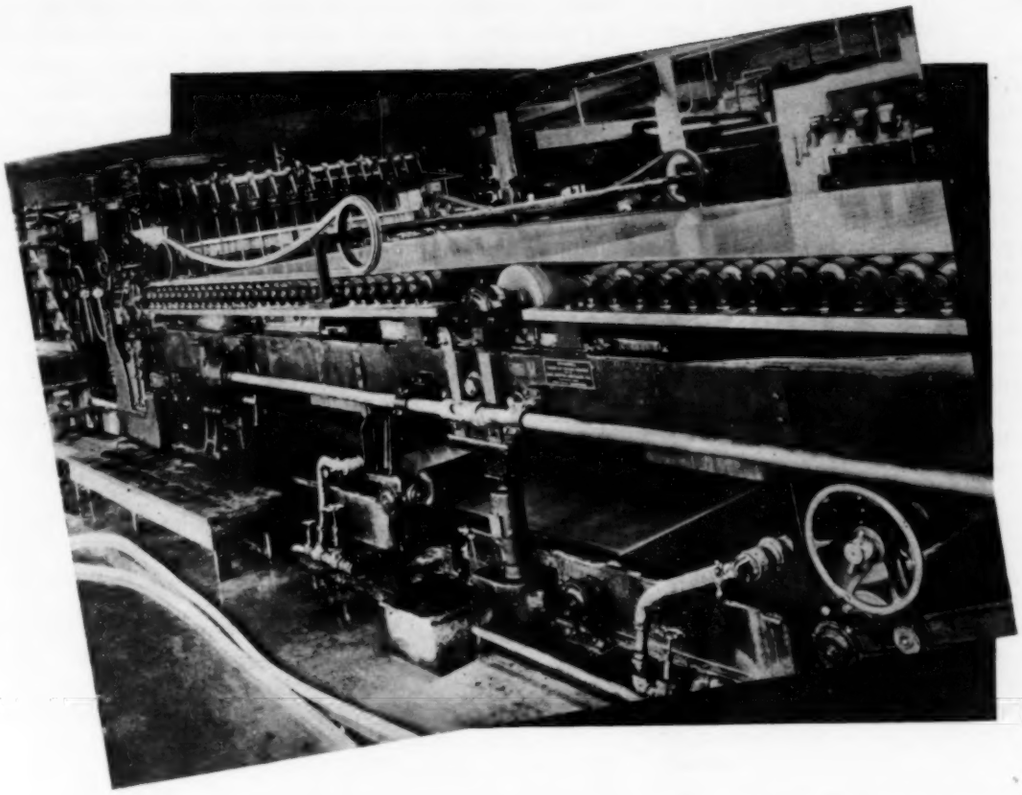
More recently attempts have been made to separate the shorter fibers in the pulp, because repeated tests have indicated that they do not contribute favorably to the strength value of the pulp. Short fibers in pulp occur either because good fibers have been cut small in chipping the wood, or because the long fibers have deteriorated and broken down into short ones in the processing operations. The practice of fibers separation has not become universally adopted, but the methods for separating short fibers are receiving careful study and future operations will probably incorporate such practice. The principle involved is based on the fact that short fibers pass more readily through a screen than do longer ones.

The reclamation of cooking chemicals from the spent cooking liquors is quite a different operation from that of handling the pulp. Briefly the processing begins with evaporation of the spent liquor, usually called black liquor, in multiple effect evaporators. To the concentrated solution is then added sodium sulphate, to make up for chemical losses in the cycle, and it then is incinerated and smelted to a fused mass. Two types of plants have become generally adopted for this purpose; the spray type and the rotary incinerator type. The molten chemicals are dissolved in water, the solution clarified to remove suspended carbon and ferrous hydroxide slime, and then lime is added to causticize the sodium carbonate content. During the smelting operation the sodium sulphate present is reduced to sodium sulphide and it is this chemical along with the sodium hydroxide formed from the causticization which serves as the active cooking chemical in the sulphate or kraft pulping process.

Recovery of chemicals from the soda process is similar to the sulphate process, but inasmuch as soda ash is used as the make-up chemical and no sulphates are present, the smelting reduction step is eliminated. In both these alkaline processes, recovery is made of the lime sludge by burning to calcium oxide in rotary kilns.

In the sulphite process the spent liquors are usually disposed of in nearby streams. Recent pressure from legislative sources has forced serious consideration to utilize the values in the liquor. Very definite progress, in which the Howard process is particularly outstanding, has resulted.

Before closing, mention must be made of the decided extension in the use of technical men in the pulp industry. The modern pulp mill now employs three to four times as many technical men as it did five years ago. Control of operations is under engineering supervision and the industry will move forward. In the future, pulps will be designed and produced for more specific uses than are present day pulps. The cellulose acetate, synthetic resin, air conditioning and many other new industries on the horizon will be future users of wood pulps. The industry is now in shape to meet these ever-changing demands on its product.



Increased rate of speed of the paper machine has resulted in many new developments such as the McDonnell fourdrinier

PAPER MAKING UNDERGOES MANY CHANGES

By CLARK C. HERITAGE

Oxford Paper Co.
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WHAT CONSTITUTES A TREND is a relative matter. A trend originates with one or more individuals displaying an indication to move in a certain direction, and terminates with an established practice for a majority of the group. Since these boundaries are not sharp, some matters will be touched upon in this discussion which perhaps are not yet proved trends, but seemingly of considerable importance, while others will be mentioned which constitute relatively old practice just coming to full fruition.

The chemical engineer entered the paper industry via the acid plant in a sulphite mill or the recovery plant in a soda or sulphate mill, solely to assist in the operation of strictly chemical processes. He was not concerned with the quality of paper upon which the success or failure of the business was based. He did, however, soon begin to apply more or less scientific methods of evaluation to the product, but from the standpoint of gaining information about the manufacturing variables rather than customer satisfaction. Thus, so far as paper quality was concerned, a miscellaneous assortment of test methods for "use properties" with peculiar names and ingenuous methods of expression of the test results came into being, whose exact utility in or relation to the business of successful paper manufacture was somewhat obscure.

It took a major business depression to focus the attention of executives on this situation. The requirements which the product must satisfactorily meet in use, began to be analyzed carefully, the relation of these to fundamental paper properties, the precise definition of these properties, the technically correct measurement of property values recently termed "instrumentation," and the establishment of suitable manufacturing specifications began to be discussed, to take form as a major trend in the industry.

Useful instruments are appearing, methods are being refined by authoritative agencies and the trend continues toward improved utility, quality and uniformity of product. The measurement of simpler, more fundamental properties, together with a clearer understanding of what existing instruments measure portends a sounder era ahead in the relationships between manufacturing, selling and use.

The outstanding quality trend has been toward a complete understanding of the "optical properties" of paper which define the visual appearance of the sheet with respect to diffuse and specular reflections, absorption, and transmission. The gap is being bridged between the precise scientific description of color, and the visual comparison against a standard exemplified by such expressions as "brighter," "redder" and "stronger." The instruments developed range all the way from the recording photo-electric spectrophotometer of Hardy to simple comparators. Each may be useful depending on the purpose to be served. The importance of wettability of the surface of paper is beginning to be recognized and studied through contact angle measurements. Perhaps as unique a testing instrument as any recently devised is one which attempts to measure uniformity of appearance of a paper when viewed by transmitted light.

With these major quality trends as a background it is easy to understand the concurrent and dependent trends which show themselves in raw materials use and quality, and process and equipment variables, all as contributing first to quality, second to economy. Two conditions with respect to quality level and uniformity seem to require brief mention at this point.

The quality level of a sheet of paper is the composite level of a multiplicity of properties. The art of paper making resides primarily in incorporating these various property values in a given sheet to as nearly an ideal extent as possible. The effect of refining is to increase one class of properties while decreasing another class. This must be handled in such a way as to gain as much as possible of the property values which increase while losing as little as possible of the values which decrease. We find, therefore, a definite trend toward the availability of a wider variety of both fibrous and non-fibrous raw material ingredients to control independently as many properties as possible.

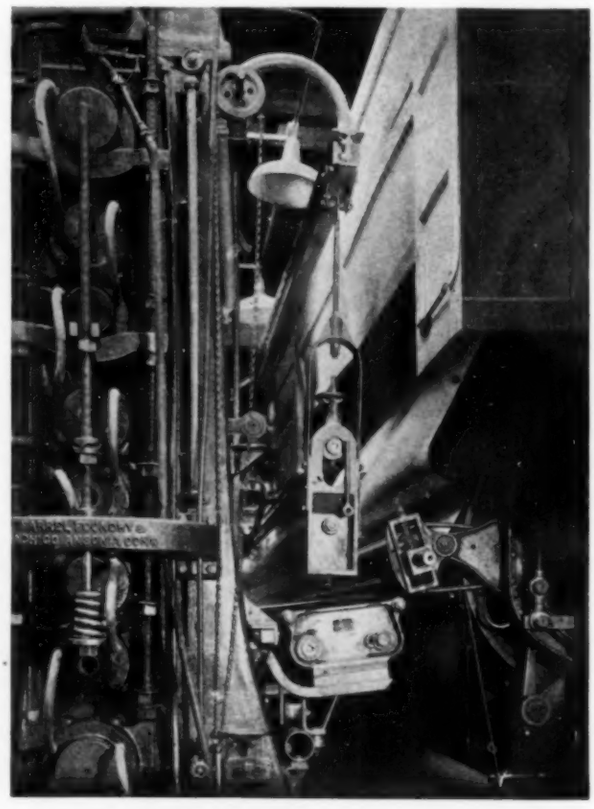
The other matter pertains to the uniformity of property values. It has often been said that the exact level of certain property values is not of so great importance to the user as that some particular level be uniformly maintained. A sheet of paper has peculiar non-uniformities, namely, wire side versus felt side, center of the sheet versus the edge of the sheet, and of course from the beginning of a reel to the end of a reel. Throughout the paper making picture the present trend is toward careful inquiry into the nature and causes of non-uniformities.

Having decided upon the quality level involved and the uniformity required the next consideration is the synthesis of the sheet with respect to its fibrous, mineral and other chemical ingredients. Water quality is receiving more attention from the standpoint of both its initial purity and freedom from coloring matter and its proper mill condition through slime prevention involving chloramine treatment. The trend with respect to fibrous ingredients is in the direction of ability to secure an increased variety of property combinations and to know more precisely what may be expected from specific fibrous materials by virtue of improved evaluation.

A wider variety of virgin pulps is coming through the utilization of a wider variety of wood species and a vigorous extension of the use of the sulphate process. The large scale production of bleached sulphate pulp of outstanding strength and color has been made possible by the introduction of so-called multi-stage bleaching processes involving the use of chlorine both as such and as hypochlorite. Bleached sulphate has not until recently been considered as competitive with bleached sulphite because of the color superiority of the latter. This gap is being rapidly closed and the trend is certainly apparent that bleached sulphate and bleached sulphite will be competitive for many grades of paper. Against sulphate of greater strength and equal color, the utility of sulphite will perhaps hinge on other property combinations. A further development of the same trend appears to be bringing semi-bleached sulphate into competition with unbleached sulphite.

One of the unfortunate situations which the paper maker is called upon to face, is the lack of a rational and useful classification of pulps together with standard methods of evaluation. Each pulp producing or using country has its own more or less standard methods for evaluation and none of them ties into a scheme which might be used internationally. The most hopeful trend in this connection is due to the activities of the Paper Maker's Association of Great Britain and Ireland, whose standard method for evaluation in the unbeaten condition was first reported in 1929.

The properties potentially capable of development in pulp are just as numerous as in paper and aside from the increasing ease of securing pulps favorable to the paper property combinations desired, the trend has been



A wide range micrometer control dampener mechanism assists the paper maker in meeting the correct moisture content

definitely toward extending the spread in the property values available.

Trends with respect to the mineral ingredients of the sheet are interesting. The urge for independently controlling the color and the opacity of paper has led to the wide acceptance of the more expensive pigments such as titanium dioxide, zinc sulphide, lithopone and titanated pigments on various base materials. The same circumstances which brought these pigments into use have also increased the use of calcium carbonate as a mineral ingredient. Calcium sulphate and sulphite are also to be mentioned in this connection.

These trends have of course long since been recognized by the producers of paper making clays with the result that these interests have studied their problems with great diligence, particularly with respect to contributing property combinations which are unique. The encouraging phase of the matter to the paper maker is the recognition by the clay producer of such paper making requirements as smoothness, opacity, ability to take or resist polishing, and ink receptivity.

The use of a wider variety of mineral ingredients and the incorporation of larger proportions of filler together with independently controlling sheet properties have led to an increasing use of various forms of starch. The trend in sizing ingredients is toward a wider variety of water repellents, stabilizers and dispersing agents.

The preparation of the stock for the paper machine, involves the compounding of the ingredients which make up the water suspension, of doing mechanical work upon the fibers, of carrying out the chemical and physical reactions which result in the sizing, coloring, loading and bonding of the finished sheet, and finally of screening the stock ahead of the paper machine wire.

Several rather definite trends are in evidence. First, there is a trend toward continuous refining as contrasted with batch refining in beaters. This of course presupposes adequate regulation of concentration of fibers and continuous proportioning of ingredients. Consistency regulators have been available for some years and new designs have come on the market recently. All are actuated by differences in resistance to flow. These have not been universally accepted because one cannot be certain that changes in apparent viscosity or resistance to flow are due entirely to changes in consistency.

So long as one pulp only is being dealt with this automatic control of consistency is certainly helpful, but as soon as mixtures of pulp are encountered together with non-fibrous ingredients the relationship between the fiber concentration and apparent viscosity is obscured. It is therefore the trend to extend to the manufacture of other grades, the practice which has existed in newsprint mills for some time, namely the consistency regulation and proportioning of the fiber ingredients separately, then doing the necessary work on the fibers, and finally proportioning the non-fibrous constituents of the sheet into the stock stream continuously ahead of the machine wire.

There are several schools of thought with respect to proportioning but two which seem to be gaining much headway are: the proportioning of the fibrous ingredients including white water and slushed broke at relatively low consistencies and then thickening the mixture on a vacuum filter to such a concentration, say 20 per cent that all white water from the paper machines can be satisfactorily reused, and dropping the thickened mixture to the beaters; the thickening of the numerous individual fibrous ingredients over vacuum filters and through screw presses which deliver granular appearing material at 30 to 35 per cent dry content to buggies which are weighed and conveyed in the usual manner directly to the beaters. There is also a trend in mills which are not self contained with respect to pulp supply to combine the slushing of incoming pulps or old papers with the refining operation in essentially one piece of equipment, thereby securing precise proportioning at the proper concentration for refining.

The reuse of the white waters coming from the wet end of the paper machine presents certain real problems. The trend is to so arrange consistencies of materials entering the beaters that the reuse of white waters need not be carried back farther in the process than the stock preparation step. There are of course materials present in these white waters which complicate the pulping and the bleaching operation if carried back into this part of the plant. The trend is undoubtedly toward more complete utilization of these filtrates if for no other reason than the avoidance of stream pollution.

Refining of fibers is necessary to slow up the water drainage rate and to develop the combination of physical properties desired in the finished sheet. The work involves roughly two actions, hydration which modifies the form and condition of the surface of the fibers, and cutting which changes the particle size distribution of the fiber mixture. The trend is to take cognizance more definitely of these two different actions, and if possible deal with each separately.

The chemical engineer dealing with refining problems is making a real effort to build some engineering fundamentals. He is simplifying and defining terms and using such devices as impact inches per minute presumably related to cutting, and contact inches per minute presumably related to hydrating. He is striving to correlate the elements of refiner resign with power consumption, capacities and property development.

The urge for continuous refining and the more general recognition of the two major results of imposing work on the fibers has accelerated improvement and invention of equipment in this field. Mechanically we may classify these devices roughly as involving the action of bar on bar, the action of disks, hydraulic action and others such as the pounding with rods.

With respect to bar on bar action there are those with the moving bars mounted on the face of a horizontal, right cylinder, parallel to the axis with the fiber suspension flowing either perpendicular or parallel to the bar; those with the moving bars on the lateral surface of the frustum of a right circular cone with the fiber suspension moving parallel to the bars; and there is a recent design in which the bars are mounted radially upon a horizontal ring the stock passing parallel to these radial bars.

The hollander, bar on bar, cylindrical type, has been streamlined; its beating roll increased in length, and

recently it is proposed to design the bars as intermeshing teeth and provide circulation by outside means. In the recently introduced Thorsen-Hery beater the roll face moves upward as it meets the horizontal moving stock stream instead of downward. Another modification is the Roto-beater in which the fiber travels parallel to the bar direction.

There has been a growing tendency to utilize more refiners of the jordan type because of their ease of control and quick response to adjustment. A further trend is toward the use of this general type of machine but with the stock entering the large end, thence being pumped by a self-contained impeller toward the small end against the centrifugal action of the rotating plug. In the recently developed Vortex beater the bars are carried on two horizontal rings, the bottom one stationary and the top one rotated about a vertical axis.

Disk refiners are continuous in operation with the stock entering near the axis and leaving at the periphery. They are available with the disks rotating either in a vertical plane or a horizontal plane, with either one or both disks rotating and in at least one design a number of pairs of disks mounted on one shaft so that the refining action is accomplished in series. The tendency is to keep speeds low so that a greater proportion of the energy may be usefully employed. Energy consumptions in certain cases is said to be as low as 2 hp. days per ton. In the case of certain designs the machine is used strictly as a refiner of the individual fibers whereas in other designs the utility is principally in the field of reducing masses of fibers to individual fibers. Higher rotative speeds are used in this case and the action of the disks appears to be the production of individual fibers without fiber debris.

So-called hydraulic beating systems involve the impingement of a high velocity jet of fibers suspended in water either against a similar and oppositely directed jet, or against a suitable target. Although this type of refiner is not yet used to any great extent, it appears to produce unique results with respect to freer stock and bulkier paper.

This resumé of refining equipment would not be complete without mention of several other new types involving the action of intermeshing members similar to gear teeth which pinch, flatten and roll the fibers, or action of bars riding against contact shoes adjustable as to pressures.

The automatic control of refining has received considerable impetus. Devices are coming into use which either maintain the power input on a predetermined schedule or record and control the pressure to which the fibers are being subjected or the clearances through which the fibers are forced to pass.

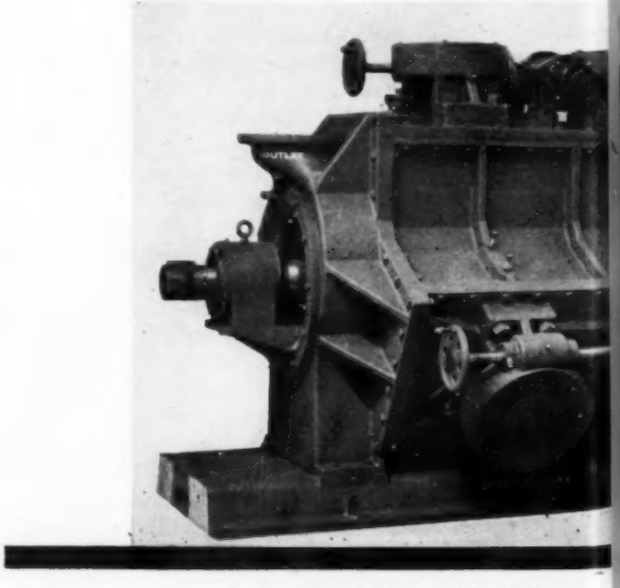
One of the operations immediately ahead of the paper machine is the separation either by selective screening or by sedimentation of foreign material and fiber bundles which have escaped defibering. The old rifflers and sand traps are seldom seen at present having been replaced by pulsating slotted screens of standard design where recent trends have involved mechanical improvement and the use of finer slots. More recently however, the solid basket centrifuge has come into use.

The paper machine serves two functions, first to produce an arrangement of solids and voids such that the dried web will display the combination of property values sought, and second to separate water starting with the initial condition of 99 per cent plus in the entering suspension and finishing with 5 per cent plus or minus in the dried sheet at the machine reel. This water removal is accomplished by gravity filtration, vacuum filtration, rolling pressure, and evaporation, all conducted continuously and in synchronization. This is greatly facilitated by the sectional electric drive. The trend toward direct driving every major part by individual motors continues to be evident as more recently applied to each cylinder mold of the board machine, these being previously driven through a "bottom felt."

The fourdrinier wire is receiving the attention it merits as a most important element in the paper machine. The trend is toward wires of finer mesh with stronger brazed or welded seams and improved edges. The edge is often the point of failure. Devices for automatically maintaining constant wire tension are being used. A new wire with a flat warp has been developed which is said to produce a superior sheet structure and surface while at the same time maintaining a normal life.

With higher machine speeds, the use of rubber covered table rolls is increasing, being lighter in weight with equal rigidity, and having advantages in that the water does not follow the roll surface throwing up against the underside of the wire. They are easier on the wire mechanically, and are more permanent, and less subject to corrosion. They are said to foul with pitch less easily and require less frequent grinding.

In order to uniformly interlace the fibers while initial water removal is going on, it is customary on all the better grades of paper to shake or reciprocate the forming area transversely to the direction of travel of the wire. Increasing machine speeds and demand for improved quality has resulted in improved devices for this purpose, which have taken the line of independent shaking of the wire at two or more points. One of the



In a new development of the bar on bar cylindrical type of refiner the fiber travels parallel to the bar direction

developments is the McDonnell fourdrinier. The tendency is to increase the number of shaking strokes per minute which now may be had in the range of 500 to 800. For the high frequencies, the tendency is to get away from the usual mechanical "shake head" and employ devices similar to those which have been used for some time for vibrating feeding devices and screens.

Since the wire is moving over the stationary top of the suction boxes, attention has been given to the reduction in friction and non-uniform wear on wire and boxes. Suction box covers made of maple blocks, end grain, impregnated with tallow are being used. Boxes are being mechanically oscillated either in the machine direction or across the machine direction or both. This is said to increase wire life by 25 to 50 per cent.

By no means all of the attention has been given to improved forming on the fourdrinier. With respect to the cylinder machine of the paper board manufacturer, nearly every machinery builder in the country has been working on the improvement of formation, through the use of lower fiber concentrations and controlled velocity and direction of flow.

The removal of the moist web from the wire of the fourdrinier machine by employing a suction couch roll needs no discussion. Recent trends in the design and operation of the suction couch include the use of two different degrees of vacuum, the first and lower being employed to seal and evacuate the couch, and the second and higher compacting the sheet and removing moisture. Each is served by the most economical design of vacuum pump. On wide, fast running machines it is becoming the practice to install a "presser roll" or a "lump breaker roll" on top of the suction couch. These are covered with soft, thick rubber, increasing the couch vacuum, smoothing down any small lumps, reducing breaks at this point in the operation, permitting gentler action at the suction boxes.

The use of suction press rolls between the couch and the dryers has likewise become standard practice. A recent development in combining suction pressing and plain pressing known as the Beloit horizontal dual press is of more than usual interest. This device is a practical manifestation of the general trend toward simplifying and precisely controlling the performance of the fourdrinier machine. Similar trends are to be observed in connection with wet and pressing methods on the cylinder machine which include the growing use of extractor rolls and suction drum rolls applied immediately following the last cylinder mold couch.

From a mechanical standpoint the last several years have seen many improvements in the dryer section. Trouble-free introduction of steam into the cylinders, removal of the condensate, application of driving power, compensation for expansion and contraction of the cylinders, handling of the dryer felts with auxiliary drying and automatic tension control, and removal of moisture laden air are well on their way to accomplishment.

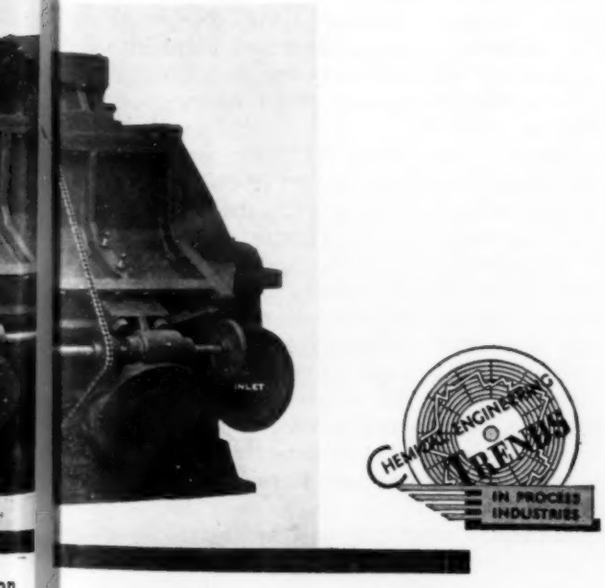
One of the most important factors is the final moisture content of the sheet since this not only concerns economy but also the physical property values displayed by the sheet. It is not surprising that one of the outstanding current trends is a real attack upon this old problem of automatic moisture content control.

The results of regular operation of the Minton vacuum dryer in connection with newsprint manufacture have recently been rather thoroughly described in the literature and perhaps the most interesting phase of it to the chemical engineer is the effect upon the property values of conducting the drying at 26 to 28 inches of mercury and a temperature of 100 deg. F. The vacuum dried sheet is definitely brighter, more opaque, softer, more porous, more absorbent, with smoother surface, somewhat lower tensile strength but greater tearing strength. The superior quality of the printed result both by typography and gravure is evident. High vacuum drying would seem to hold interesting possibilities in future developments.

Trends in calendering of importance are the partial substitution of more plastic rolling for dry calendering, by means of a single pair of breaker or smoothing rolls located part way back in the dryer section, and the adaptation of pneumatic or hydraulic controls to the calender stack to provide balanced, and reproducible pressures and temperatures.

One further important trend is to be mentioned. Although the application of various suspensions, emulsions or solutions to either or both surfaces of the paper web during its travel along the paper machine is old, impetus has been given to these practices recently through demands for uniformity and particular property combinations in the finished sheet. The patent literature is voluminous in this field and the materials proposed for use cover a wide range of pigments, fillers, adhesives and chemicals.

It is evident from the foregoing that management must in the future set up adequate obsolescence reserves, because paper making equipment and processes even ten years old are likely to be too costly against more modern competitors. The trends are moving rapidly toward continuity and precise control of operations, toward uniformity and variety of property combinations in the sheet.

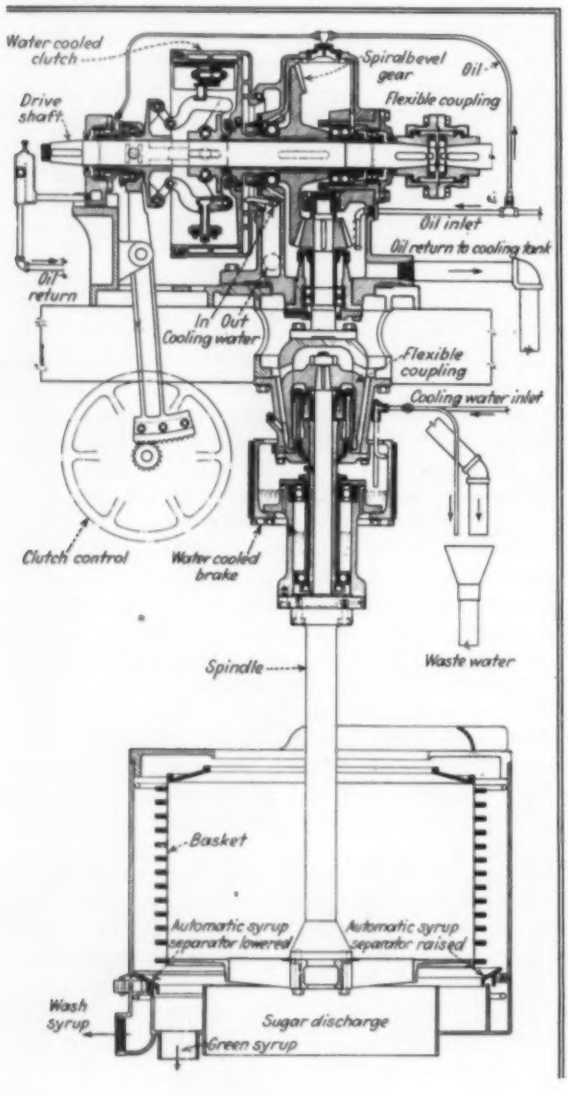


GEARED CENTRIFUGALS SPEED UP SUGAR PROCESSING

By DANIEL GUTLEBEN
Chief Engineer, Pennsylvania Sugar Co., Philadelphia, Pa.

CHEMICAL ENGINEERING TRENDS IN PROCESS INDUSTRIES

Fig. 1—Cross section of Roberts high-speed gear-driven sugar centrifugal



AMONG the outstanding developments of the last few years in sugar refining has been the perfection of two new machines which have made possible striking improvements in the industry's methods of operation. The Stevens "hot mingler" has permitted attaining the desired high temperature of magmas and massecuites in a minimum of time, without danger of overheating the sugar, while the Roberts gear-driven, high-speed centrifugal has speeded up centrifuging cycles, permitting more thorough purging of the crystals with the use of less wash water. Although both of these machines were developed primarily for sugar, it is not unlikely that they will prove equally useful in other industries making crystalline products.

An article and flow sheet in the November, 1935, issue of *Chem. & Met.* discussed these developments briefly. Now, however, as a result of considerable operating experience at the Pennsylvania Refinery, it is feasible to explain in greater detail what is being accomplished.

In the refining of cane sugar, the object is to take a raw material containing about 96 per cent sucrose and remove the impurities, producing a crystalline product of almost 100 per cent purity. This, in itself, is not particularly difficult by present day methods, the chief problem being to do so economically with the smallest possible loss of sucrose and the least consumption of steam, power and labor. This means that a process which will reduce the amount of water necessary to wash the crystals, lessen the sugar dissolved by the water and accomplish more thorough purging will decrease the liquids in process, reduce the load on the evaporators and vacuum pans and lessen the need for reprocessing.

Centrifugals play an important part in sugar refining, being used both for the washing of the raw sugar and for the recovery of crystals from their mother liquors at various stages in the process. To dissolve the film present on the crystals of raw sugar they are first

Fig. 2—View of high-speed, gear-driven centrifugal battery in plant of Pennsylvania Sugar Co.

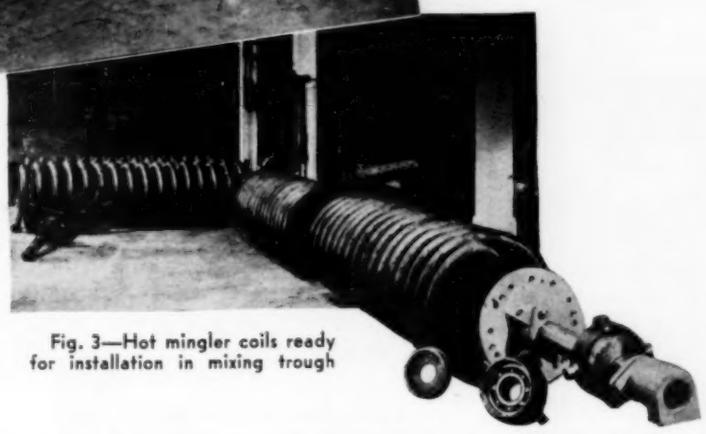


Fig. 3—Hot mingler coils ready for installation in mixing trough

mixed with a saturated syrup at the wash or "affination" station, forming a magma which is then centrifuged. The "green" syrup which separates is recycled for further use as "affination" syrup. The crystals are washed with water and the wash syrup retained for further processing. The washed crystals, now several shades lighter in color than the raw sugar, are dissolved in dilute syrups, or sweet waters, obtained in later stages of the process, and the solution adjusted with lime to a pH of 7.0. It is then mixed with kieselguhr and filtered in pressure leaf filters. The clear solution produced is decolorized by passage through bone char filters and evaporated, first in a multiple effect evaporator, and then in a single effect vacuum pan. Crystallization takes place in the pan and the completed "strike" or massecuite of white crystals and mother liquor, or syrup, is centrifuged and the crystals washed with water. The crystals are dried, screened and packed, or otherwise prepared for sale. The green syrup or separated mother liquor is then treated for the recovery of further sugar.

In the process of conserving values so far as possible, other liquors and syrups originate in the refinery and these also undergo treatment for the recovery of sugar. For example, wash waters are produced in washing the raw sugar bags, the raw sugar itself, the finished sugar, the leaf and the char filters. These are either suitably processed to permit crystallization, or used in dissolving the raw sugar prior to filtration. When a given syrup finally becomes so high in impurities that it will crystallize only on cooling, the liquor is run from the pan into a crystallizer where cooling and agitation aid the growth of the crystals over a period of several days. The resulting low grade massecuite is centrifuged and the sugar, similar to a raw sugar, is returned to the start of the process. The mother liquor, or syrup, now too low in sucrose for further treatment, is the final molasses of the refinery and may be disposed of for food or for the production of industrial alcohol.

This brief outline of refining has shown two types of use for centrifugals: in the washing of raw sugar, and in the recovery of sugar of various grades after evaporation and crystallization. The new higher-speed centrifugals, owing to their much more rapid acceleration and higher final speed, exert a much higher separating force, producing dryer crystals and removing a greater part of the syrup clinging to their surfaces. Consequently less wash water is required and, at the same time, what water is used can be of higher temperature. It flashes through the crystals so rapidly that less sugar is dissolved per quart of water used.

However, without the hot mingler, the full benefit of the new centrifugals could not be attained. Sugar magmas and massecuites have a high temperature coefficient of viscosity, their fluidity increasing sharply as the temperature increases. For rapid centrifuging and thorough separation of the syrup, the feed to the centrifugals must be as fluid as possible, which is to say that it must be at a relatively high temperature at the moment of centrifuging. This the hot mingler accomplishes, either through heating a cold magma or massecuite, or by maintaining the massecuite at the temperature of the vacuum pan after crystallization.

The Roberts centrifugal, which operates at 1,500 r.p.m. (or higher) and accelerates in 40-45 sec., has a number of new features, the most important of which is in the method of driving. Earlier sugar centrifugals were either direct motor driven or driven by belts individually or in group drive, attaining speeds of 1,000-1,200 r.p.m. The new driving arrangement employs a group of six machines, belt-connected to a 250-hp. motor, each machine being driven through spiral bevel gears from a constant-speed horizontal line shaft to which each centrifugal is connected at the appropriate time by means of a water-cooled friction clutch. A system of forced oil circulation and a water-cooled brake are provided. These details will be apparent from a study of Fig. 1. Another feature shown in the drawing is an automatic syrup separating valve installed in the bottom of the curb. This is an annular ring which, when lowered, deflects into the inner gutter; and when raised, traps liquid flowing down the curb into the outer gutter.

In normal operation of the new centrifugal, a peak of 70 hp. is required during acceleration, but only 8 hp. is

needed to maintain this speed. The six centrifugals operate on a cycle of 2¾-3 min. and are scheduled to start at ½ min. intervals so that the peak loads never overlap. Hence a group drive provides an advantageous arrangement, particularly when, as in the Pennsylvania Refinery, a mechanical time cycle controller is used. This controller, which is set in motion when the centrifugal is started, turns on the wash water at a predetermined time; operates the curb valve for separating the green and wash syrups; opens a spray of steam or hot water for washing the curb, when this is desired; and finally disconnects the driving clutch and applies the brake, without the operator's attention.

Test Data Comparing Operation of New Gear-Driven and Old Direct-Connected Centrifugals

	Test A[1]		Test B[2]		Test C[3]	
	% Dry Subs.	Purity	% Dry Subs.	Purity	% Dry Subs.	Purity
Affination syrup	82.4	69.3	80.8	72.5	71.6	80.5
Raw sugar	99.2	97.4	99.5	96.6	99.3	96.6
Magma	95.7	90.4	93.9	90.2	90.4	91.8
Green syrup	86.5	72.4	80.7	71.9	71.7	81.2
Wash syrup	84.6	78.8	78.0	83.0	Mixed	Mixed
Washed sugar	99.7	99.6	99.5	99.4	99.3	98.5
Water used, qt	7.5		7 to 8		12 to 14	
Raw sugar cryst. dissolved, per cent	9 to 10		7 to 8		15 to 20	
Length of cycle, min	2½		2½ to 3		3½	
Maximum r.p.m.	1,500		1,500		1,020	
Time to top speed, sec	45		45		120	
Drop in pur. aff. and green	4–5 points		4–5 points		2.5 points	
Per cent aff. syrup in magma	20 to 25		25 to 30		35 to 45	
Temp. aff. syrup, deg. F	164		175		135	
Temp. magma before heating	94		108		100	
Temp. magma after heating	182		155		...	

[1] 12 Gear-driven centrifugals, four operators; power: one 250 hp. motor for six centrifugals; capacity: 150 tons per day per centrifugal, data average of 6 tests.
[2] 12 Gear-driven centrifugals, four operators; power: one 250 hp. for six centrifugals; capacity: 150 tons per day per centrifugal; data average of 18 tests.
[3] Six self-discharging centrifugals; one operator; power: one 25 hp. motor for each centrifugal; capacity: 150 tons per day per centrifugal; data average of 6 tests.

The hot mingler is a spiral coil of extra heavy pipe which is mounted on a horizontal axis in the bottom of a V-shaped mixing trough and rotated at 20 r.p.m., or thereabouts. In the Pennsylvania Refinery installation, the wash station mingler has a hot-water circulation of 500 g.p.m. and a heat-transfer rate of 45 to 60 B.t.u. per square foot, hour and degree F. The water is supplied by a temperature-controlled heater and reaches the mingler coil at 222 deg. F., leaving at about 215 deg. F. The water circulating pump consumes 30 hp. and the mingler drive motor 25 hp., although this may rise to 40 hp. when the magma is cold and dry at the start.

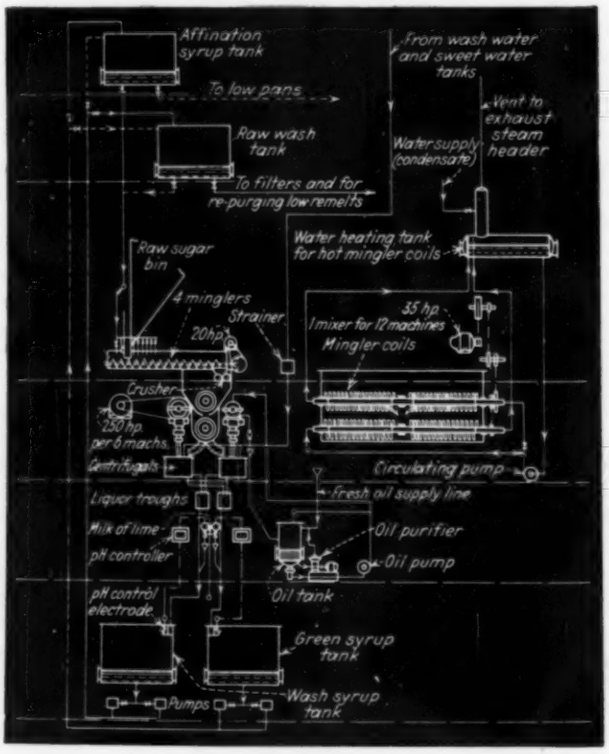
This combination of moving heating surface and low-temperature heating medium presented by the hot mingler makes possible rapid and uniform heating of sugar and syrup without localized overheating, and consequent caramelization. At the wash station, heating the affination syrup to pasteurizing temperature and subsequent heating of the magma to 170 deg. F. in the hot mingler makes it possible to produce a free-purging magma of requisite fluidity with as high as 97 per cent dry substance. This compares with the 90 per cent common by earlier methods. Hence, a greater weight of crystals can be handled per centrifugal and, owing to the fact that raw sugar so treated is more completely purged in the centrifugal, substantially less wash water need be used. This, combined with the factor of increased filtering speed, reduces the amount of sugar crystals melted to 7-8 per cent as compared with 15-18 per cent by ordinary practice. Hence, a greater proportion of the raw sugar reaches the vacuum pans without by-processing.

Although the problem is slightly different in the case of recovery of crystals from massecuites later in the process, similar benefits are derived from the use of the hot mingler. When it is used to keep white sugar massecuites at the temperature of the pan prior to centrifuging, the pan can be boiled to a higher density, thus increasing the yield, which sometimes reaches 50 per cent. As in the case of the wash station, the syrup is more completely removed, less wash water is required, and, incidentally, there is the advantage that the finished sugar has a higher luster owing to the lessening of solution of the sugar and the reduction of the frosting effect of drying the syrup film on the crystals. When low-grade massecuites are to be centrifuged after crystallization in crystallizers, it has been customary to reheat the crystallizers just before discharge. This has had the desired effect of lowering the viscosity, but it has also caused melting of the sugar. Installation of a hot mingler in the mixer preceding the centrifugals, however, will accomplish reheating quickly and only in such volume as is required by the centrifugals, thus avoiding excessive melting.

Tests at Pennsylvania Refinery

The foregoing has been presented in a general way and to those engineers more specifically interested, the following results of tests at the Pennsylvania Refinery may be illuminating. The set-up is indicated in Fig. 4. At the beginning of the week, the raw sugar is mingled with any available remelt syrup. The purity of this

Fig. 4—Flow chart of affination station at Pennsylvania Refinery, showing syrup tanks, hot mingler and centrifugals



syrup (percentage of dry substance which is sucrose) may be 65–70 and the Brix (percentage of dry substance) must be at least 80, so as to be saturated at 180 deg. F. and avoid dissolving sugar crystals. When mixed with the raw sugar and heated in the hot mingler to 160–170 deg. F., the syrup dissolves the film on the crystals, with little solution of sugar. The hot magma is fed to the centrifugals during acceleration between 300 and 500 r.p.m. When full speed has been reached and 90 per cent or more of the syrup has been filtered off, washing is accomplished with 6–8 qt. of water at a temperature of 180 deg. and 30 lb. pressure—or with sweet water from the char filters. The washed sugar attains a purity of 99.5 per cent. The green run-off syrup (affination syrup for the next cycle) is maintained at constant volume, density and purity by proper timing of the automatic syrup separator. Both the green and wash syrups are held at pH 7.0 by a Leeds & Northrup automatic controller which feeds milk of lime for neutralization. Sterile conditions and positive operation of the syrup separating valve are maintained by steaming the curb at two-hour intervals. At the end of the week the recirculated affination syrup, at a purity of about 70 and in the amount of 6,000–7,000 gal., is boiled into remelt (to be returned to the raw sugar melting) and the run-off syrup reboiled into low-grade massecuite, thus eliminating coloring matter without the use of char. The excess wash syrup, having a purity 8 to 10 points above the green syrup, is filtered through char, whereby the purity is increased 3–4 points to a final purity of 85.

In the accompanying table are shown the results of tests conducted with the new gear-driven 40 x 24-in. centrifugals, compared with the old direct-connected, self-discharging 40 x 24-in. centrifugals. In tests *A* and *B* the syrup produced during 15 seconds after the wash water was turned off was added to the green syrup to maintain volume and purity equal to that of the original affination syrup. In Test *A*, the magma temperature was too high, causing melting of the sugar. The magma temperature of 161 deg. F. now ordinarily attained with six machines operating will later be raised to 170 deg., it is expected, with certain revisions of the equipment. This will increase centrifugal capacity and reduce the production of green and wash syrups.

Heating the magma for the old 1,100 r.p.m. machines produced some increase in washed sugar purity, but much more wash water was required. With high-speed machines wash water at 180 deg. does a better job and less is required than at lower temperatures. On the low-speed machines, however, it cannot be used without excessive melting.

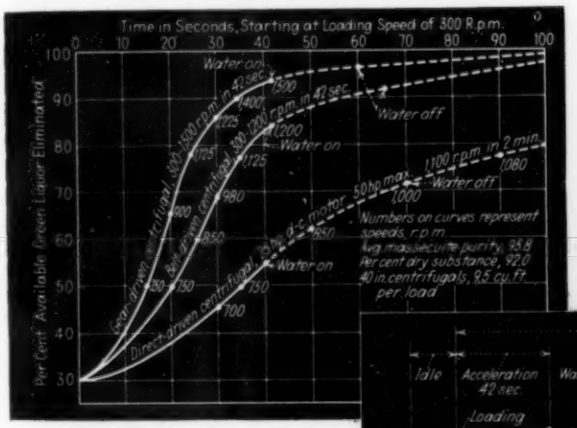

Time in Seconds, Starting at Loading Speed of 300 R.p.m.
Per Cent Available Green Liquor Eliminated
Water on
Water off
Water on
Water off
Water on
Numbers on curves represent speeds, r.p.m.
Avg. massecuite purity, 95.8
Per cent dry substance, 92.0
40 in. centrifugals, 9.5 cu. ft. per load
Gear-driven centrifugal, 300-1500 r.p.m. in 42 sec.
Belt-driven centrifugal, 300-1200 r.p.m. in 42 sec.
Direct-driven centrifugal, 50 hp. d-c. motor
1,100 r.p.m. in 2 min.

Fig. 5, Left—Graphs showing purging rates of three types of centrifugal operating on white sugar massecuite

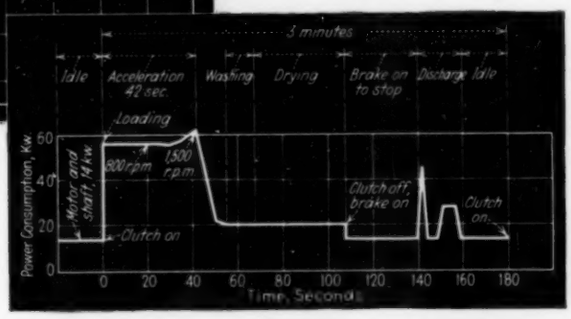


Fig. 6, Below—Generalized time cycle-power chart for one high-speed centrifugal; two men operate six machines

Tests were made to show the length of time required to purge the green syrup at various rates of acceleration. These are recorded in Fig. 5, comparing the results on white sugar massecuite using respectively the old direct- and belt-driven centrifugals and the new gear-driven ones. The high-speed machines removed 93 per cent of the syrup in 40 sec., and the slow-speed, 54 per cent.

Other tests were concerned with the power consumption of the new machines. As has been pointed out, the common drive shaft of the six machines is driven at constant speed. It has been found that with the clutch shoes set to slip at 70 hp. the basket attains its speed of 1,500 r.p.m. in 45 sec. In Fig. 6 is a generalized time-power graph of one machine showing a 14-kw. power consumption for the motor and shaft and a peak of 64 kw. total as final speed is reached. Only 20 kw. is required during the washing and drying parts of the cycle. Other power consumption tests were made to show the flywheel effect of those machines already at top speed on the acceleration of the machine just starting. Operating the six machines concurrently according to the regular schedule, the power consumption per cycle (not including power absorbed by the shaft and motor) was 1.21 kw.-hr., compared with an average of 1.50 kw.-hr. per cycle when each of the six machines was operated individually, with the other five inoperative.

In conclusion, we have noted the spectacular reduction in wash and green syrups made possible by the use of highly fluid magma in raw sugar washing, and the comparable improvements with white sugar and low grade massecuites. It is evident, also, that the hot mingler and high speed centrifugal permit a larger percentage of the original crystal to reach the pan floor without by-processing. Impurities are thus removed in more concentrated form, while the higher purity of the washed sugar permits the recovery of more finished sugar with less steam and probably less use of char.

TRENDS IN ORGANIC C

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IN A BROAD SENSE, any organic chemical that can be made by synthesis can be made from the paraffins, olefines and aromatic hydrocarbons derived from petroleum. The present discussion, however, will be limited to only those products which are now manufactured on a commercial scale, or which give real promise of being so made within the severe limitations imposed by the fundamental necessity of profit.

Industrial organic chemical processes of considerable magnitude have been developed. Yet they have involved very little new chemistry—in many cases chiefly because the engineering problems encountered in the adaptation of new laboratory processes to large-scale operation have been so difficult, time-consuming and costly in their solution. The cost of experimental work and new engineering methods has been only partially responsible, however, for the slow application of long-known aliphatic chemistry to the chemical utilization of petroleum and natural gas. There have been several other important retarding factors in this particular field: (1) Coal has been a cheaper source than petroleum or natural gas for water gas, acetylene through carbide, and the benzenoid hydrocarbons. (2) The complexity of petroleum has made difficult the separation of pure raw materials. (3) Until very recently, the magnitude of the developed aliphatic chemical industry has been too small to interest the directors of the oil and gas industry. (4) The necessity for solving problems of the first importance first has left little time and money for ventures into new fields. (5) Perhaps greatest of all retarding factors has been too much orthodoxy on the part of technical men and executives in regard to the possibilities offered by new products and new fields.

Chemists both in the oil and gas industry and in the the organic chemical industry have usually viewed the possibilities of synthetic organic products from the standpoint of already developed markets—a point of view which looks backward rather than forward. The plan of making synthetic products to fit into the pattern of existing markets is perfectly proper, so far as it goes, but it makes no provision for those developments which grow out of pure research, which create new demands, develop new markets, and occasionally even change the whole face and character of the industry. In such work, which has not been instigated by existing demands, every conspicuous success has been a heresy of either chemistry or salesmanship.

This last statement is so important that it deserves concrete illustration. In 1919, the directors of a well known chemical company ordered work on the manufacture of ethylene glycol discontinued and allowed their option on the patents to expire, on the ground that ethylene glycol was only a substitute for glycerine and had no established market or uses. Related products such as ethylene oxide, glycol ethers and ethanol amines were of course not considered because they had no established uses. The sale, at a later date, of millions of pounds of ethylene glycol at prices substantially higher than those of glycerine was a heresy of orthodox salesmanship.

The manufacture of synthetic ethyl alcohol from ethylene stood condemned by all orthodox chemists for thirty years on the basis of the published accounts of Fritsche's work on synthetic ethyl ether and the amount of sulphuric acid supposed to be required and the cost of reconcentrating it. Its successful commercial manufacture could only be done by chemical iconoclasts. A little critical study of the matter would have shown that Fritsche did not know how to make ethylene, how to absorb it efficiently, nor how to concentrate sulphuric acid, and that he knew very little about making ether.

The orthodox condemned McAfee's process for treating oil with aluminum chloride on the ground that the aluminum chloride could not be economically recovered. McAfee's answer was to manufacture aluminum chloride cheaply enough to throw the residues away or burn them.

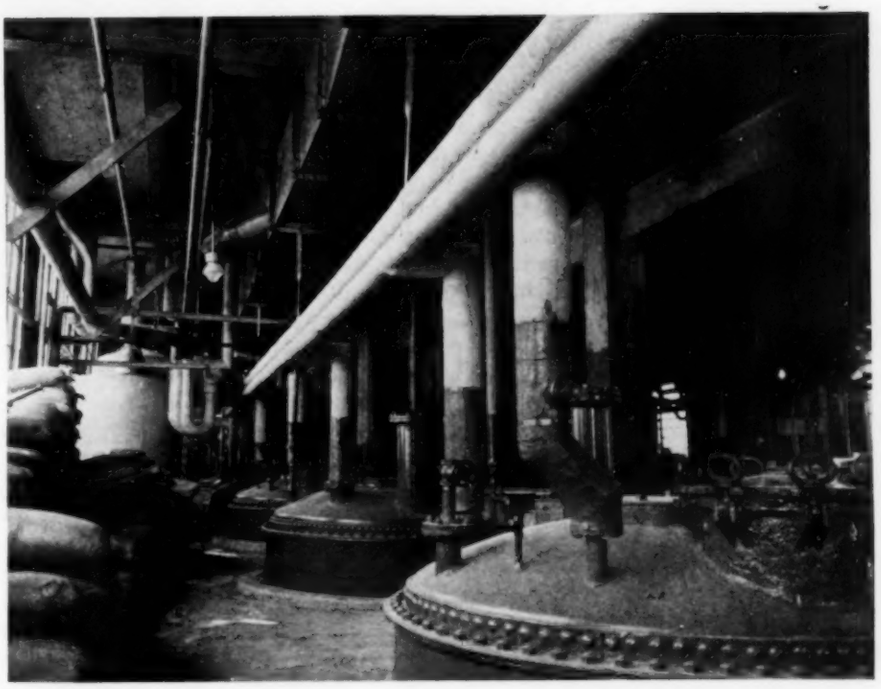
In recent years, some of these old obstacles have been overcome, and the production of synthetic organic chemicals from petroleum has advanced to a position of industrial significance. Some of the factors responsible for this development have been the following: (1) the widespread installation of oil cracking processes with the production of byproduct gaseous olefines; (2) improvement in the fractional distillation of condensible gases and light hydrocarbons, thus making it commercially feasible to produce pure hydrocarbon raw materials and pure chemical products from them; (3) great increase in qualified chemical research personnel in both the chemical industry and the oil and gas industry; (4) fair increase in what Teeple called "educated money;" and (5) great increase in the amount and variety of organic chemicals required for solvents, synthetic resins and plastics, petroleum solvent refining processes, antiknock motor fuels, refrigerants, and other products.

CHEMICALS

FROM PETROLEUM AND NATURAL GAS

A more detailed consideration of some of these factors and a brief survey of what has been done should give a fair idea of the trends and tangible possibilities in this rapidly expanding field.

Up until the present, the direct manufacture of pure organic chemicals from oil and gas has been practically limited to substances derived from hydrocarbons of not over five carbon atoms. The reasons for this are that the difficulty of separating pure hydrocarbon raw materials increases tremendously with hydrocarbons of more than five carbon atoms and also because many of the organic chemicals for which large markets exist can be made from such simple raw materials as ethyl alcohol, acetone, acetic acid, acetic anhydride, most of the lacquer solvents and ethylene glycol.



Typical equipment for the manufacture of organic chemicals

The belated adoption of methods of fractional distillation by the petroleum industry is well known. For many years the light gasoline recovered from natural gas was "weathered" in vented tanks to allow the lower boiling hydrocarbons to escape. Later, about 1923, fractionating columns or "stabilizers" began to be used. Then came the low-temperature low-pressure method for the fractionation of low-boiling hydrocarbons such as propane and butane. For the separation of such materials as isobutane (b.p. —12.2 deg. C.) and n-butane (b.p. —0.3 deg. C.) the new Podbielniak fractionator would probably be very effective. Until recently, equipment designers having experience in gasoline recovery and stabilization have attempted to apply the method of absorption and distillation under pressure to the separation of the two low-boiling hydrocarbons, ethylene and propylene. However, as is clearly indicated by the vapor pressure curves of these substances at low temperatures, their separation is much easier by the low-temperature fractionation of gases rich in them. In this way it is comparatively easy to separate about 90 per cent of the ethylene from a cracked gas containing about 27 per cent ethylene, as a fraction containing at least 98 per cent ethylene and the rest ethane.

Many special chemical methods of purification and separation are helpful in the manufacture of pure products. Butadiene, which is present along with a mixture of other close-boiling hydrocarbons in the C_4 fraction obtained in the vapor phase cracking of petroleum, can be selectively removed by treating with a cold aqueous solution of cuprous chloride and ammonium chloride and subsequently heating the cuprous chloride addition product.[1,2] The butadiene thus obtained can be polymerized with mono-olefines to form highly unsaturated high-boiling oils which may be useful as drying oils, or it can be energetically polymerized with olefines to form resins.[11]

No serious attempts to utilize butadiene for the manufacture of synthetic rubber appears to have been made anywhere except in Russia, where a great deal of work has recently been done in this field. In the United States, cracking conditions which produce butadiene and other highly unsaturated products are for the most part avoided. Since the proportion of butadiene produced even under high temperature vapor phase conditions is very small in relation to the other products, its chemical utilization appears to depend upon a profitable outlet for these other products.

Isobutene, another component of the C_4 petroleum fraction, is so extremely reactive to dilute mineral acids that they may be used to remove it selectively from the fraction without polymerizing the butadiene associated with it. This fact makes possible the production in quantity of tertiary butyl alcohol or other derivatives of isobutene. Hydrogenation of the dimer, di-isobutene, yields iso-octane which is of great interest as a special aviation fuel.

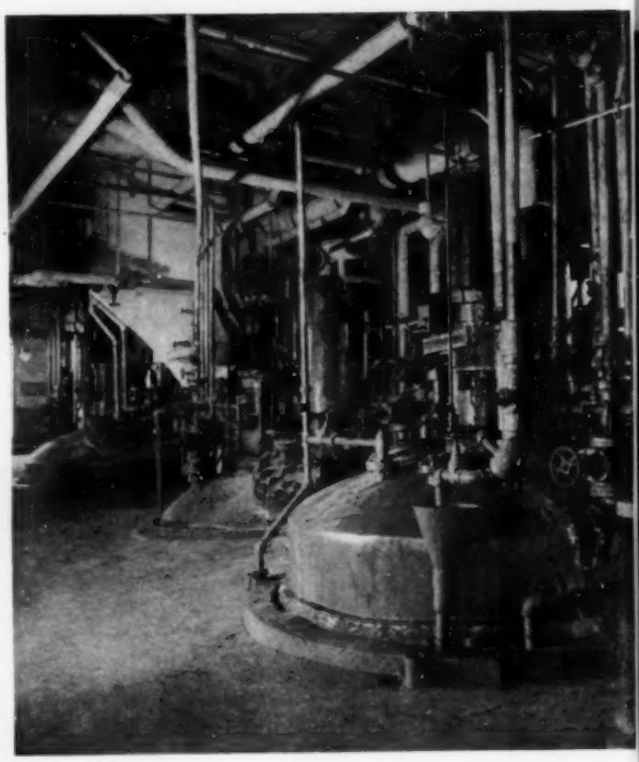
Group separation methods may also be used for the separation of hydrocarbons from petroleum. The extraction of aromatic hydrocarbons from straight run kerosenes by the liquid sulphur dioxide method of Edeleanu is well known. The method can also be applied to gasolines to remove benzene, toluene and xylenes, but for this purpose it has not proved economical. Probably group separation by solvents, as for example the separation of olefines from paraffins and naphthenes can be carried much further. The rather wide temperatures of miscibility of olefines, naphthenes and paraffins with aniline, is suggestive. Ethylene is much more soluble than ethane in alcohol and its separation in this way has been proposed.[13]

There is still an abundance of benzene in the United States. But toluene is still in great demand as a diluent in lacquers, and it is possible that the demand for naphthalene for the manufacture of phthalic anhydride and the hydrogenated products, tetralin and decalin, may equal or even exceed the supply. The war time demands for benzene and toluene make their manufacture from petroleum desirable in countries in which very little by-product coke is made, such as Russia, Italy and Japan. In earlier work the proportion of benzene to toluene produced from petroleum was about two to one. More recent work shows that it is possible to produce much more toluene than benzene—in some cases from two to three times as much.[8]

Products From Ethylene and Acetylene

It is well understood by chemists that many of the organic products which can be made from acetylene can be made also from ethylene. The chemistry is simple, but the question of relative costs is complex and involves many more factors than yields.

A great deal of effort has been expended upon the production of acetylene by the decomposition of gaseous hydrocarbons at high temperatures. Storch and Golden[10] state that where natural gas is available at 2 cents per 1,000 cu.ft., it is feasible to make ecetylene from the gas by the method studied by them. But cheap natural gas is a good deal of a will-o'-the-wisp. It is really cheap



only where there are no industries to use it, or where an industrial plant owns its own wells. At Baton Rouge, La., acetylene for making acetic acid is being obtained in large quantities as a byproduct in the production of hydrogen from petroleum refinery hydrocarbon gases.[5]

While considering the cost of raw materials it should be pointed out that the price value of cracked refinery gases and also of propane and butane promises to be affected by the so-called polymerization processes, by which these hydrocarbons are converted into gasoline of high octane value. A plant has just been completed at Borger, Texas, to produce 2,000 bbl. per day of such gasoline from propane and butane. There hydrocarbons, as well as cracked refinery gases are accordingly worth more than fuel value, and if gasoline returns to the value it had in 1922, i.e. 14.5 cents f.o.b. mid-continent refineries, this difference will be greater.

The present situation regarding ethylene and acetylene as raw materials may be indicated by considering some of the synthetic products now being made from them. Ethylene made by cracking hydrocarbons is the commercial raw material for ethanol and ethylene glycol in the United States. Synthetic ethanol made by catalytic hydrogenation of acetaldehyde, or from ethylene made by partial hydrogenation of acetylene, has evidently not been carried out industrially either here or abroad. Much the greater part of our synthetic acetic acid is made from acetylene, through acetaldehyde, although a plant in England is reported to be making 20,000,000 lb. per year by the catalytic oxidation of fermentation ethyl alcohol. This latter instance suggests the commercial production of acetic acid from synthetic ethanol made from ethylene. According to Partridge,[9] if synthetic ethanol costs 16 to 18 cents per gallon, the cost of acetic acid made from it

Nitration and suphonation reactions play important roles in organic synthesis

by catalytic oxidation should not be more than 3 cents per pound.[6,7] It will thus be apparent that the competition between acetylene and ethylene in this series of synthetic products is close.

N-butyl alcohol is being produced from acetaldehyde by condensation and hydrogenation. Smaller proportions of n-hexyl and n-octyl alcohol are made in the same process, the condensation naturally not giving 100 per cent C_4 products. Carbyl sulphate and the hydrolyzed product, isethionic acid, are made economically by absorbing ethylene in a solution of sulphur trioxide in cold liquid sulphur dioxide.

During the World War, interest in ethylene glycol was aroused because of the advantages of its derivative, dinitro glycol, in low freezing nitroglycerine dynamite. Also, ethylene chlorohydrin, the intermediate product in the preparation of ethylene glycol from ethylene, was used in the older method of preparing mustard gas. For the manufacture of ethylene chlorohydrin, glycol and other derivatives, the ethylene obtained from cracked hydrocarbons gases by low temperature fractionation[8,12] or by fractionation in the presence of solvents,[4] is advantageous because of its high purity.

Ethylene oxide made by the direct catalytic oxidation of nearly pure ethylene promises to supply an economic raw material for the production of ethanol amines and glycol ethers.

Products From Propylene

The first account of the manufacture of isopropyl alcohol from propylene was published by Ellis in 1920. This alcohol competes with ethyl alcohol in many of its industrial applications. The recent announcement that isopropyl ether, blended with selected gasoline stocks, and with 1 c.c. of Ethyl Fluid per gallon, makes an aviation fuel of 100 octane rating, may place the manufacture of isopropyl ether on a par in volume with the most important organic chemicals made.

The manufacture of acetone by the catalytic dehydrogenation of isopropyl alcohol is now well established. This development has paved the way for other industrial processes of great interest both commercially and theoretically. Chief among these is the conversion of acetone to ketene and the manufacture, from ketene, of acetic anhydride, also the manufacture of acetoacetanilide and acetoacetic methyl and ethyl esters from diketene. Acetic anhydride is now one of the most important synthetic organic chemicals. It is made chiefly from acetylene through ethylidene diacetate, from acetic acid by thermal decomposition, and from ketene. The present consumption of acetic anhydride in the United States is probably more than 100,000,000 lb.

The manufacture of ketene on an industrial scale is another illustration of technical success in the face of facts which apparently condemned such a process. A series of published researches indicated that the yields were very low, about 10 to 15 per cent. Finally, Hurd and Rice showed that with a number of small conversions, about 15 per cent per pass, the ultimate yield is very high.

One can hardly pass the subject of C_3 synthetics without mentioning propionic and acrylic acids. The value of propionic acid as cellulose propionate is generally understood to have been established. Whether these acids will come from ethylene, propylene or butene derivatives, or from some other source, is not yet apparent.

The present brief review cannot include all of the synthetic products made from petroleum or natural gas, which have established themselves in industry. There are many other products of mutual interest to the petroleum industry and the synthetic organic chemical industry, for example, oxidized paraffins, extreme pressure lubricants, anti-oxidants, products for improving diesel oils, solvents for refining lubricating oils by solvent extraction, products for reducing the pour points of lubricating oils and products for improving their viscosity characteristics.

Progress so far can be said to have been mainly in the utilization of the more simple hydrocarbons, which development has been favored by relatively low priced raw material and comparatively simple chemistry. A few successful undertakings have broken through the crust of conservative orthodoxy which has until recently obstructed both the scientific approach and the enterprise of chemical manufacture in the field of petroleum chemistry.

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TEXTILES AWAIT IMPROVEMENT OF MANY UNIT

Kier room in a large bleachery where cotton is boiled out at 10-15 lb. pressure prior to bleaching

WELL OVER 700,000 tons of chemicals is consumed annually by the textile industry Yet few textile men think of their industry as one of the process group. There are many chemical engineering problems involved in the manufacture of textiles. Yet there are probably less than a dozen graduate chemical engineers in the field. It is not surprising, therefore, that many of the unit operations in the textile industry are still carried out by rule-of-thumb methods. On the other hand, the textile industry is not so backward as some writers have made it seem. It has made noteworthy progress in solving some of its chemical engineering problems. It still offers many opportunities for the rationalization of processes.

The function of the textile industry is to take some 3½ billion pounds of raw fibers annually and convert them into usable textiles. This requires 100 billion gallons of water, in addition to the 700,000 tons of chemicals mentioned previously. Obviously, there are many problems involving materials and fluids handling, mixing, heat transfer, and separation. Likewise, control of time, temperature, pressure, humidity, and other conditions are vitally important in certain processes. Probably no other industry has a more varied and intricate struggle against corrosion of equipment. Although there are chemical engineering problems in practically every textile mill, they are particularly important and acute in the 2,000 plants in which one or more of the operations of scouring, bleaching, dyeing, printing, or finishing are performed. These plants (hereinafter referred to as finishing plants) consume approximately 90 per cent of the dyes and chemicals used in the industry.

The first requisite of a finishing plant is a copious supply of pure, soft water. With the demand for better and still better quality in finished textiles, this requirement has become more and more stringent. It is natural, therefore, that water treatment has received a great deal of attention in recent years. Many companies which formerly used raw water in processing have found that it is now necessary to purify and/or soften it. Other companies have found that purification and softening equipment installed ten or twelve years ago, say, is no longer adequate. Hence, a number of textile mills have, within the last year or two, installed water purification systems of the most up-to-date type, with hydraulically operated valves, automatic or semi-automatic control, and modern operating tables that simplify the work of the attendants.

With the exception of a small percentage which is evaporated during drying operations, the 100 billions of gallons of water entering the finishing plant must be disposed of after it has been used. The usual method of disposing of trade waste in the textile industry is to discharge it without treatment into a sewer or stream. A few mills have put in equipment for clarifying waste liquors. A still smaller number is recovering some of the chemicals used in processing.

Textile wastes vary greatly in composition, not only from plant to plant, but also from department to department in a given plant, and from hour to hour in any one department. While it is possible to separate the wastes from the several departments of a mill, separation of the wastes from one department, as a rule, is impractical. That is, highly contaminated waste liquors from the dyeing operation, for example, cannot readily be separated from the wash waters used in rinsing the goods after dyeing. As a result, it usually is necessary to mix all the liquors from one department in tanks or basins and then treat this comparatively large volume of waste.

Even in the few mills which are now treating trade

OPERATIONS

By WINN W. CHASE
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waste, there is no standardization of methods and equipment. Some plants are using circular clarification tanks with revolving scraper blades. Others have installed rectangular tanks with traction-type scrapers and surface skimmers for removing scum. Disposal of sludge is a problem which has not been satisfactorily solved.

Experimental plants have been established in the South, with funds granted by the Textile Foundation, to determine the best methods for disposal of wastes from cotton finishing plants. Work thus far accomplished indicates that lime in the proportion of 5.9 lb. to 1,000 gal. of effluent is the best precipitant for most dyehouse wastes and that the amount of lime required is lessened by recirculation of the precipitated sludge. Waste from indigo dyeing responds to a copperas-lime treatment; waste from sulphur dyeing is best neutralized with sulphuric, hydrochloric, or nitric acid; mixed with alkaline waste; and then treated with alum.

A New England plant is treating waste from the wool finishing operation by removing the short fibers by means of traveling screens, adding acid or alkali as needed to neutralize, adding alum, passing through sand filters, and further subjecting the liquors to the action of a bacterial culture furnished by the State.

Realizing the possibility of more stringent Federal and State legislation against stream pollution, textile men are at present on the watch for better and less expensive methods for treatment of trade waste.

Aside from the legal necessity of treating waste liquors, there is the possibility of recovering valuable chemicals used in processing or of obtaining salable byproducts. Some plants are recovering caustic soda from mercerizing liquors and are purifying and concentrating it for re-use. Others are treating waste soap liquors with copperas to precipitate iron soaps, adding sulphuric acid to give free fatty acids (which are used in making new soap) and copperas (which is recovered). Still others are putting waste from the wool-scouring operation through centrifugal extractors to remove dirt and suspended matter and then through high-speed centrifuges to recover the salable wool grease. Some of the finishers are treating waste tin liquors used in weighting silk with lime to precipitate the tin as hydrate or oxide and are then drying the sludge in spray dryers to 10 per cent moisture content. (See *Chem. & Met.*, Oct. 1928, p. 607.) On the whole, however, little attention has been paid to the matter of recovery of chemicals from the various processes involved in textile manufacture and finishing.

Drying of textiles in the form of raw stock, yarn, or fabric is one of the most important and least understood of textile operations. During the last decade the design and efficiency of dryers of various types have been greatly improved. Use of hot air for drying, zoning of heat to permit high temperatures at the entering end of the dryer, and addition of conditioning chambers to deliver dried yarns or fabrics with a uniform regain (moisture content) are among the advances which have been made. Recirculation of air, good insulation and other refinements have so increased the efficiency of dryers that in some cases it has been possible to remove 1 lb. of moisture for each 1.5 lb. of steam supplied by the boilers.

During 1936 the United States Institute for Textile Research inaugurated an investigation of the fundamental principles underlying the drying of textiles. This study will undoubtedly reveal a great deal of information concerning critical and safe drying conditions and will pave the way for further improvements in drying operations and equipment.

As a rule, mixing of size solutions, printing pastes, finishing compounds, and other materials is carried out today in the same manner as it was 50 years ago. Here and there one will see a jacketed kettle and mechanical agitator or even a colloid mill; but for the most part the wooden tank and paddle still remain the favorite tools for mixing.

Evaporating, refrigeration, and distilling are unit operations which are met with only infrequently in the textile industry. In plants where large quantities of caustic soda are recovered from the mercerizing process, use of multiple-effect evaporators has proved advantageous. Refrigeration equipment is used to a limited extent for cooling mercerizing liquors and solutions employed in the production of certain types of permanent finishes. Commercial development in 1935 of the Frosted Wool process, in which the grease in raw wool is congealed by cooling the stock to a temperature of about —35 deg. F., then shattered to dust and separated from the fibers by mechanical agitation, opens a new application for refrigerating equipment.

In one or two mills in this country the fatty and greasy matters in wool are removed by treating the stock in closed equipment with an organic solvent, such as petroleum ether. The solvent containing the wool-grease is distilled and collected for re-use and the residue left in the stills is collected and sold. At the present time a number of other mills are showing interest in this process, which is one of the few operations in the textile industry where distillation plays a part. In view of the fact that rayon knitting yarns are lubricated with mineral oil compounds, it appears that a solvent method for scouring hosiery and other knit goods made from rayon might be evolved.

Filtration problems have received attention in connection with the purification of water, in caustic recovery, and in a few other operations. Straining of dye liquors,

printing pastes, and finishing compounds in most plants is done by the crudest of methods.

Fluids handling in the textile industry is carried out in every conceivable way. For transporting dye solutions from the color room to the dyeing machines, pails or tanks carried by hand or pushed on flat trucks may be used. For transporting kier liquors, pipe lines and centrifugal pumps may be employed. No real engineering thought has been given to the matter and there is much room for improvement.

For intraplant transportation of raw stock, yarn, and cloth, the more progressive mills have availed themselves of the latest developments in materials-handling equipment. Conveyors of both pneumatic and mechanical types and electric tractors are widely employed. In addition, various devices designed specifically to facilitate movement of fabrics from one part of the plant to another have been developed.

In textile mills, many of the fluids used are highly corrosive; and the pipe lines, valves, pumps, and containers employed today often are not of the most satisfactory construction. This is rather surprising, as textile men have for several years evinced a growing interest in the problem of corrosion and have made noteworthy progress in the use of corrosion-resisting materials in dye machines, carbonizing machines, and other equipment in which actual processing of the goods is performed.

Not only is it necessary to guard against corrosion of the equipment itself, but materials of construction must be chosen which do not affect the solutions used, causing for example, decomposition of hydrogen peroxide or dulling of the shades of dyes. Textile mills have pioneered in the use of Monel Metal, nickel-clad steel, stainless steel, and other corrosion-resisting metals and alloys. Where these are not suitable, rubber-lined or glass-lined equipment, chemical stoneware, and various other materials are employed. It is probably not too much to say that consideration has been given to the corrosion-resisting properties of every piece of new wet-processing equipment installed in the last four or five years.

Another field in which the textile industry ranks among the leaders is in that of air conditioning. In cotton spinning and weaving mills particularly, modern humidifying equipment is the rule. In up-to-date dyehouses and finishing plants ventilating systems are provided to remove steam and other vapors and to prevent condensation, dripping, and fog.

Again, the importance of control of temperature in the mixing and application of the various solutions used in textile processing is widely recognized, and in the last few years use of temperature recording and control apparatus has grown rapidly. One of the latest trends is toward the use of automatic time-temperature-cycle control equipment in such operations as wool dyeing. Another recent trend is the installation of apparatus to control automatically a number of variable conditions. Thus on a warp sizing machine, it is being found advantageous to control the temperature and height of size in the size box, temperature of the drying cylinders, and percentage of moisture in the sized and dried warps leaving the machine.

In the last ten or fifteen years there has been considerable improvement in the methods and equipment used in bleaching, dyeing, finishing, and other operations peculiar to textile processing. One notable trend has been toward the substitution of continuous processes for batch processes. Another has been the further development of "range finishing," in which two or more separate operations are carried out continuously. Take the carbonizing of wool goods, for instance. Former practice was to wet out the fabric for 30 to 45 min. in a tank with sulphuric acid or aluminum chloride solution, pass it through rubber-covered squeeze rolls into a box or truck, transfer the fabric to a centrifugal extractor, remove from the extractor, and carry it to a dryer where it was fed in by two men, one at each side. The procedure followed today in up-to-date plants is to use continuous equipment consisting of a saturating machine, squeeze rolls, vacuum extractor, and dryer and carbonizer. One modern unit has the capacity of three of the older type, gives a better quality of product, and—through savings in labor and chemicals—reduces operating costs to less than one-quarter of what they were under the old system.

Similar examples could be given of improvements made in other finishing-plant operations. On the other hand, there are still many processes which are susceptible of just as much improvement. To name one, there is the bleaching of cotton piece goods; approximately 4,000,000,000 yd. of cotton woven fabrics is bleached annually, but no entirely satisfactory continuous method has yet been evolved. Some of the problems still to be solved in the textile finishing industry are in the realm of the chemist some belong to the physicist, some await the chemical engineer.

In the middle of the 19th Century a number of the most eminent chemists in the world were connected with the textile industry. Revolutionary advances were made in the chemical processing of textiles. Then for a time chemical progress slowed down to permit mechanical development to catch up. More recently—and particularly within the last decade—many new textile chemicals and new textile processes have been evolved and much of the progress of the last few years can be attributed to the efforts of textile chemists who have gone into the plant—often with the cooperation of the mechanical engineer—and have more or less unwittingly applied chemical engineering principles to the solution of their problems. Yet, on the whole, the textile man is barely aware of the existence of the chemical engineering profession. It would be to his advantage to capitalize on the possibilities of such training and experience.

Once again the processing of textiles is on the verge of revolutionary changes. A new fiber—staple rayon—is just beginning to make itself important. Introduction of synthetic resins, latex, various cellulose esters, and other chemicals new to the textile industry is making possible the creation of new finishes and even new textiles hitherto unknown. Application of these materials is calling for the development of new processes and new types of equipment. Never in the history of the textile industry has there been a greater need for the chemical engineer, and never before have greater opportunities awaited him.

Methyl methacrylate may be worked by hand as well as by machine

Economic and Engineering Trends In PLASTICS

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THE SCOPE of the plastics industry comprises a variety of chemically dissimilar substances and mixtures, most of them of organic nature and resinous character, which are shaped by casting, molding or machining. They are used for quantity production of articles of great variety, mostly of small size and of utilitarian or ornamental character. The several hundred plastics that are commercially available are of 15 to 20 types. As a result of research, changes in raw material costs, the growth of new outlets and the disappearance of old uses many changes occur in the industry from one year to the next.

The trends in the plastics industry during the 25 years prior to 1933 have been discussed by Weith and Mory.[1] That period witnessed the birth of most of the commercially important plastics of today. However, since that time several important changes in trends have occurred which make it advisable to give a brief account of these more recent developments.

Before the days of synthetic resins the principal molding material was shellac, but the low softening temperature put it at a disadvantage in comparison with synthetic resins. Shellac lost many of its markets although some continued to be used in the making of phonograph records. Recently it has had competition for this market from such plastics as cellulose acetate, vinyl and other resins.

Perhaps the best prospects for a return of shellac to a position of some importance in the plastics industry will result from an investigation now being carried on in an effort to increase its resistance to heat. It has long been recognized that its softening temperature is increased by prolonged heating, but it now appears that through suitable compounding with chemical agents shellac can be made to cure in the molds in somewhat the manner of the recognized heat-setting resins, and rapidly enough to permit of molding at an economically short cycle.[3]

Recent years have brought advances in the quality of the nitrocellulose used for plastics. The use of this material as an interlayer in windshield safety glass, where clearness of vision is essential, has necessitated intensive effort to improve clearness and cleanness and resistance to the deteriorating effects of heat and sunshine.[2] The haziness of the interlayer, which made earlier nitrocellulose windshields unsatisfactory, particularly in night driving, has been traced to the technique of nitration and other causes. Purification of water supplies, improvement in the mechanical features of nitration to promote uniformity, pH control throughout the stabilization and purification of the nitrocellulose, and the use of alloy steels in nitrating and mixing equipment have all contributed to the marked improvement.

As raw material for nitrocellulose, purified wood pulp is coming into competition with cotton linters. Paralleling this is an interest in the nitration of the wood pulp in the form of compact thick sheeting, known to the trade as dense cellulose. Such material, cut in the form of uniform tiny chips, is so much less voluminous than other forms of cellulose, such as linters, that several times as much can be nitrated in existing equipment, and a much smaller bulk of acid needs to be handled for a given production of nitrocellulose.

The nitrocellulose plastics, and the more recently developed cellulose acetate plastics, have traditionally been made in blocks of limited size, from which are cut sheets of desired thicknesses. This batch production in units of a few hundred pounds has been essential for economical manufacture of the wide variety of colors, mottles, etc., which the industry has always had to furnish. But for the production of large poundage of a single material, in only one or two standard thicknesses, the old block process is uneconomical, and, as applied to safety glass interlayer, unsatisfactory from the standpoint of quality. The sequence of separate operations, several carried out in open equipment, gives too much opportunity for the entrance of dirt and dust. Furthermore, the production of the sheeting in separate sheets of rather limited size is not conducive to economy in cutting out the various sizes and shapes required for safety glass, particularly for windshields and other panes of an automobile.

Probably the most noteworthy advance in the plastics industry in recent years has been the development of methods of manufacturing safety glass interlayer in continuous sheeting by processes of extrusion. The product is cheaper than that of the former process, and both clearer and cleaner. Also, the wide sheeting in continuous lengths can be more economically cut to size.

For some years, nitrocellulose was the base material of practically all safety glass interlayer, and it still forms a fair proportion of the total now being made. However, improvement in the quality of cellulose acetate and reduction in its cost have made it much more popular for this purpose. In the case of the acetate, the relatively hard, stiff sheeting used a few years ago has been superceded by softer, more pliant compositions, which give more satisfactory protection over the range of temperatures in which safety glass may be used. The development of these interlayers of new type has involved considerable study of plasticizers, of which several new individuals are coming into wide use.

For general fabrication, a cellulose acetate plastic has an advantage over a nitrocellulose plastic as it is capable of being firmly welded to itself by pressure at a temperature which will not cause decomposition or discoloration. Consequently articles may be molded from cellulose acetate in granular form by methods entailing small loss of material. No chemical change takes place during the operation, as in the case of the so-called heat-setting molding compounds, and accordingly cellulose acetate compounds, like other permanently thermoplastic molding materials, may be remolded, so that imperfect articles and other waste can be reused.

The very recently developed technique of injection molding comprises the forcing of a molding compound, heated in a reservoir to a fluid condition, into a closed mold cavity, and maintaining it under pressure in the mold until it is cooled sufficiently to be rigid.[3] The mold is kept cool, and the soft material forced into it sets to a rigid condition within a comparatively short time.

The molding cycle with an injection machine is shorter than that of compression molding, so that with a single mold cavity the hourly production of an injection molding press is several times that of a compression molding press. Commercially, however, more than a single mold cavity is used in either case, and the greater capacity of a compression molding press makes possible the greater multiplication of the number of mold cavities, which tends to overcome the handicap of a longer cycle.

Noteworthy in the expansion of the fields of application of plastics has been the injection molding of small parts of delicate or complicated shape and the successful molding, by compression, of articles of size recently considered beyond the scope of the technique, such as cabinets and housings for radios, office machines and merchandise scales.

Unfilled transparent cellulose acetate sheeting, containing a suitable but limited percentage of plasticizer, has been found ideal for the manufacture of high quality sound records, such as are demanded for electrical transcription broadcasts. Given a matrix of high quality, comparatively free from distortion or suppression in any wave length, the use of dirt-free acetate sheeting, which adds practically no background noise, gives sound reproduction of a high order, which will tolerate considerable amplification.

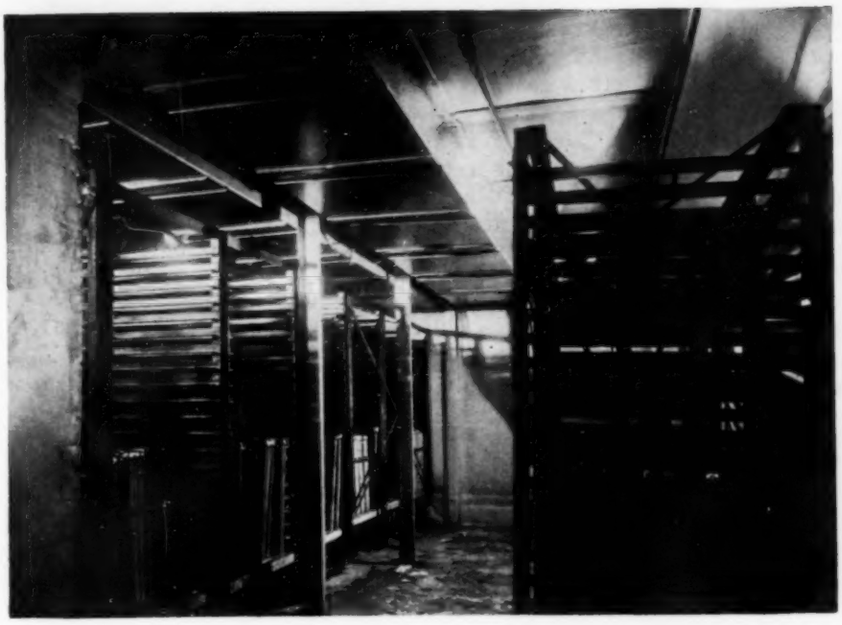
Ethyl cellulose, a new product in America, seems to have characteristics which will permit it to stand on its own feet in competition with the older derivatives of cellulose. Its comparative freedom from discoloration by light and its maintenance of toughness at low temperatures

Primary shapes of a new resin, methyl methacrylate

make it appear promising for the sandwich material of safety glass. It has a wider range of compatibility with modifying ingredients, particularly resins and waxes, and thus gives promise of being more versatile in its application, than nitrocellulose or cellulose acetate.

Phenol-formaldehyde resins are now available in special types to meet particular purposes. Odorless and "bleed-proof" molding materials are made for containers and closures—alkali-resistant materials for soaps, shaving creams, etc., and acid-resistant compounds for vinegar, catsup, and the like. Molding materials of high shock resistance are made for camera cases, ledger covers, etc. A specially developed heat-resistant resin is made for brake linings for the modern high-powered automobile. Unfilled compounds are available which mold as readily as the filled materials but yield a transparent article.

The demand for economy in molding has stimulated the



Cast phenol-formaldehyde resin being cured in the trucks on the left

development of resins of greater speed of hardening, with corresponding shortening of the molding cycle. Another type, of particularly ready flow and comparatively slow rate of hardening, is designed for injection and transfer molding. A compound of improved resilience has been developed to permit threaded articles to be forcibly stripped from the molds, instead of being unscrewed from the molds.

Laminated phenolic resins of special types are used for refrigerator strips, for bearing material suitable for heavy duty bearings in steel and paper mills, and for casings for high explosives.[8]

The principle of injection molding has been adapted to the heat-setting resins in the technique known as transfer molding.[9] A limitation of the amount of resin in the heating cylinder to that required for a single filling of the mold, together with means for completely emptying the heating cylinder after each stroke, prevents the obstruction of the orifice by permanently hardened material.

There has been considerable advance in the study of the flow and plasticity of molding materials under heat and pressure, and tentative standards have been developed for the determination of flow, and for the hardening characteristics of heat-setting resins.[8]

Heat-setting resins analogous to the phenol-formaldehyde resins are made by the reaction of phenol with furfuraldehyde. The large molecule of furfuraldehyde, with its comparatively complicated structure and its conjugated double bonds, differs in its action and effects from the simple molecule of formaldehyde, furnishing in the single substance a resinifying agent, a hardening agent and a plasticizer. The resin differs, both in behavior during the cure and in the characteristics of the finally hardened article, from the phenol-formaldehyde resins. In particular, its curing characteristics make it better suited for injection or transfer molding. It is believed that the probability of further reduction in the cost of furfural, not long ago a chemical curiosity, assures a bright future for these resins.[3]

Quite different in appearance from the molded phenol-formaldehyde and different also in method of fabrication, are the so-called cast phenolics, namely, phenol-formaldehyde resins furnished in rods, tubes, sheets, blocks, etc., from which the finished article is made by machining operations. Like the cellulose derivative plastics, the cast phenolics owe much of their popularity and wide use to their availability in bright attractive colors, including translucents and transparents. The labor cost of fabricating articles from the cast resins is considerably higher than that of molding from molding powders, but the fabricator has no investment to make in expensive molds, which must be amortized over the articles produced, and hence the cast resins offer in many cases the cheapest means of producing articles in comparatively limited quantity, such as costume jewelry, millinery and clothing accessories, of which the styles may change too fast to warrant investment in molds.

Analogous to phenol-formaldehyde resins are the urea-formaldehyde. In the form of molding powders these are now handled by similar technique with something approaching the molding economy of phenol-formaldehyde. Their availability in translucent white and bright tints justifies their higher cost. Current resins show improvements in ease of molding and in strength of the molded article.[10] Some of the handsomest of recent commercial moldings that are available are of urea-formaldehyde.

Wood flour has formed the principal filler in phenol-formaldehyde molding compounds, but it is not suited for use in the more recently developed molding compounds of delicate color, such as the white and pastel shades of the urea plastics. Here the usual filler is a highly purified and bleached wood fiber, which must meet specifications as to cleanness, color and fiber length.[3]

Urea-formaldehyde in cast form, with glass-like transparency, has not lived up to its promise of ten years ago, and is practically off the market because of its tendency to craze and crack which is objectionable.

Modern architecture and interior decoration are using increasing quantities of laminated plastics, for walls, furniture, lighting fixtures, etc. The darker colored laminated phenol-formaldehyde is being supplemented by laminated urea-formaldehyde, which is available in

light tints and of translucency which permits its use in lighting fixtures.

The much publicized soybean plastic utilizes the protein of this versatile bean in conjunction with phenol and formaldehyde. It is a heat-setting molding compound, and superior in moisture-resistance to earlier protein plastics.[5]

In the field of vinyl resins, one of the first to go into commercial production was an interpolymer of vinyl acetate and vinyl chloride. Polymerized vinyl acetate is of excellent appearance, flexible, and resistant to deterioration by light, but has an objectionably low softening temperature. Polymerized vinyl chloride, on the other hand, has an inconveniently high softening temperature and is subject to discoloration by heat and by light. Mixtures of the two are of little value, but a co-polymer of the two in proper proportions seems largely to combine the desirable features of the two individuals. Considerable variation in the properties of the product is possible, according to the proportions of the two ingredients and the technique of preparation of the co-polymer. That used for molding purposes ordinarily contains about 87 per cent polyvinyl chloride.[6]

More recently developed, and now on the market in small quantities, are resins derived from polyvinyl acetate by hydrolysis and interaction with aldehydes. These contain in their macromolecules both the resulting polyvinyl acetal and polyvinyl alcohol, as well as, in some cases, residues of unaltered polyvinyl acetate. Considerable variation is possible, according to the viscosity of the initial polyvinyl acetate, the extent of its hydrolysis, the extent of replacement of hydroxyl by acetal groups, and the selection of the aldehyde used. As a class these acetal resins are of good appearance and of excellent toughness. Certain individuals have been proposed for general molding use, while others have distinct promise for safety glass interlayer. Extensive development of this field in the near future seems probable.[5,7]

Polystyrene, now being made in moderate commercial quantities both here and abroad, has not as yet entered the field of general molding, but because of its excellent electrical properties and its easy adaptability to the technique of injection molding it is found useful for the production of molded parts for use in radio and other small electrical equipment. The earlier difficulty with crazing seems to have been largely overcome through control of the processes of manufacture. The present rather high price of the material is capable of substantial reduction in the event of increase in the commercial production.[3]

Probably the most interesting of the new resins are the polymerized esters of acrylic and methacrylic acids, of which the most important is methyl methacrylate.[4,6] Methyl methacrylate will attract notice primarily because of its beauty and its adaptability to a variety of fabricating techniques, but it possesses also other less obvious points of merit. Its beauty is due to its complete transparency and freedom from color, which permit of its being colored practically to any specification whatsoever. As a cast resin, methyl methacrylate can be furnished in the form of rods, tubes, sheets and blocks, in crystal and in colored transparent, in pure white or colored translucent and also in white and colored pearls. It has color possibilities beyond those of any cast resin heretofore available. As a molding powder, in crystal and other colored transparents, and in white and colored translucents, methy methacrylate can be handled by the ordinary technique of thermoplastic molding, by either compression or injection.

The resin is not infusible, like phenol-formaldehyde, but its softening temperature is higher than those of most thermoplastic materials. The inability of the resin to absorb moisture, and the fact that no volatile solvent is used in its manufacture, ensure permanence of dimensions and freedom from warpage. Other resins of this class have been proposed for safety glass interlayer and other uses.

In making resins of the alkyd type, the use of terpene-maleic anhydride has shown interesting results.[8] In the field of cold molded plastics, those of the organic or oil-asphaltic combination type, formerly used for wiring devices, are becoming of less importance, because of the greater economy of molding such parts from hot-molded phenol-formaldehyde of the heat-setting type with the use of multiple-cavity molds. Accordingly the trend has been towards the inorganic or refractory type of cold molded plastics, in which important improvements have been made in reducing water absorption, with benefit to the dielectric properties, and in the adaptability of the material to the molding of more intricate parts. Thus more extensive use of these materials becomes possible, taking advantage of their superiority in heat-resistance and arc-resistance to the ordinary phenol-formaldehyde molded insulation.[9]

With the advances in the technical excellence and variety of plastic materials available there has fortunately arisen a consciousness of the importance of design. The manufacturer of molded articles can now enlist the services of commercial designers, who are not merely versed in the sound principles of artistic design but also familiar with the technique and problems of commercial fabrication, and thus capable of laying out a design which is not merely artistic but also practicable and economical in manufacture.

The business man, the engineer, the designer have ceased to think of plastics as mere substitutes for something else; they are now definitely convinced that plastics are materials to be reckoned with, and they plan accordingly. To meet modern demands, the manufacturers of plastics have introduced new materials, have greatly improved the older and better known ones, and have materially reduced costs.[5]

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RECENT DEVELOPMENTS IN PRESSURE INDUSTRIES

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IN THE SIX YEARS since *Chem. & Met.* devoted its entire September, 1930, issue to high pressure technology, at a time when the principal products of high pressure synthesis were methanol and ammonia, and petroleum hydrogenation was just getting under way industrially, so much progress has been made in high pressure applications as more than to justify the predictions then made. Industry has not lagged in the solution of the peculiar engineering problems involved, nor in the perfection of high pressure technique. And university research has maintained its high standards of quality, although lack of adequate finances has limited quantity in many schools. Now, therefore, is perhaps an appropriate time to review what has come out of six years of business adversity—not the stalemate that might have been expected, but progress in improvement of existing installations as well as in the establishment of new ventures. Although no attempt has been made to assign relative importance, the following are outstanding accomplishments of the period.

Higher Alcohols—The commercial production of aliphatic alcohols of molecular weight higher than that of methanol was accomplished early in the period. The catalytic treatment of carbon monoxide and hydrogen mixtures under pressure results in the formation of normal propyl, isobutyl, and numerous other alcohols of varied uses. In general this development is a logical extension of methanol synthesis and can be accomplished separately or simultaneously with the production of methanol. The equipment is identical for either type of operation. Recent progress has been made in finding operating conditions and catalysts for producing mixtures separable by distillation.

Hydro-Solvents—An interesting corollary to the production of hydrogenated lubricating oils has been the development of a process for making hydrocarbon solvents. Suitable petroleum fractions are treated catalytically with hydrogen under pressure and distilled to give liquids of desired volatility. These solvents are finding an outlet, and to some extent replacing more expensive oxygenated compounds.

Iso-Octane—The petroleum industry has definitely entered the chemical field. Making use of some of its cheap and plentiful hydrocarbon raw material it promises to continue the contribution of new products as research develops. Iso-octane is an example. Although still used largely as an automotive fuel having a high octane rating, it serves as an example of what the future may develop along more strictly chemical lines. The process involves the polymerization of isobutene and the hydrogenation of this polymer to form iso-octane.

Polymer Gasoline—Pressure application has yielded a partial answer to the refiner's old problem of what to do with refinery gas. Three processes for the utilization of such gas are in use for the manufacture of liquid fuels. These developments involve either pressure or catalytic polymerization of olefines. The resulting high anti-knock liquid is being blended with lower quality fuel according to market requirements. This development, therefore, not only increases the quality of motor fuel, but also the quantity which may be produced from a given amount of crude petroleum.

Urea—The successful commercial development of a chemical reaction which has been known to chemists since 1870 is at hand. For many months Wöhlers "first synthetic organic chemical" has been on a tonnage basis. Ammonia and carbon dioxide are the starting materials and white crystalline urea is the product. The importance of this development to the fertilizer industry is a matter that the next few years will answer. In the meantime the availability and price of this interesting chemical will doubtless cause activity in many directions where nitrogen compounds are concerned.

Phenol and Aniline—High quality products from monochlorbenzene continue to come on the market—evidence that the equipment problems of the early processes have been satisfactorily solved. Considering these compounds as representative of many other industrially important ones, we must be prepared for an extension of these direct methods of synthesis aided by pressure.

Amines—A small but significant production of methyl amines certifies to the success of the catalytic pressure reaction involving ammonia and methanol. A long list of other aliphatic amines is to be considered in the logical extension of this method of production.

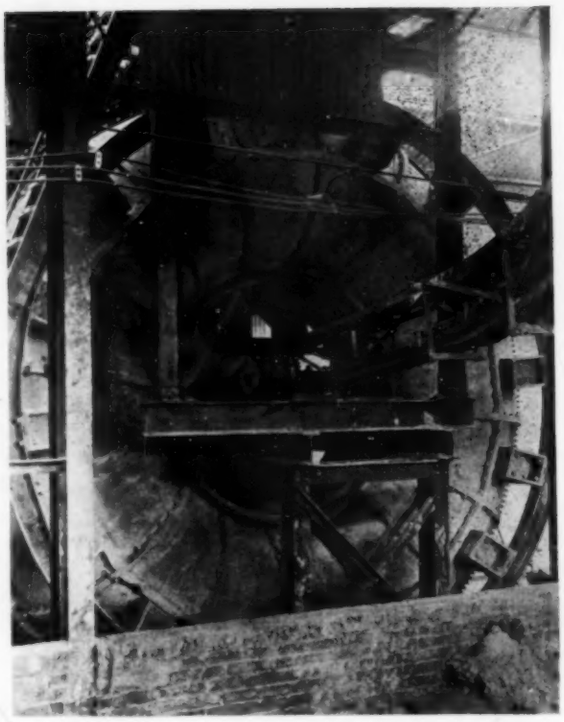
Miscellaneous—Among the accomplishments of the past six years one must include discoveries which are as yet in the development stage. The commercial feasibility of proposed processes is yet to be tested. If a fair percentage of problems that are now in the semi-works stage mature, we are on the threshold of a period of great activity. One may list among these potential developments the reaction of carbon monoxide with aliphatic alcohols to produce acids; carbon monoxide with hydrocarbons to produce ketones and acids; the combination of olefines and water to synthesize alcohols; and reactions of olefines with acids to form esters. In general it seems reasonable that the possibilities of utilization of water gas, light petroleum hydrocarbons, and such materials as alcohols and ammonia will be greatly extended.

Superphosphate Process Made Continuous

SUCCESSFUL development of a continuous superphosphate process has been announced in England where it was worked out in the fertilizer plant of J. & W. Maxwell, Ltd. Owing to the fact that the product of the reaction of sulphuric acid and phosphate rock, originally a thin slurry, sets up to a hard rock-like mass during the course of the reaction, many difficulties have hindered the engineer who sought to make the reaction continuous. The method evolved by the English firm is the subject of patents and is available for licensing through L. A. Mitchell, Ltd., of Manchester. It differs markedly from the process employed in the continuous production of triple superphosphate by the Tennessee Valley Authority and has an advantage over the latter process in that the product is delivered from the machine in a finely divided state, requiring no grinding. In neither process is drying necessary.

The new Maxwell method is aptly referred to as a continuous mixing and excavating process, for the continuously mixed rock and acid are fed to a rotating den for solidification, from which the resulting superphosphate is continuously cut and delivered in a fine, powdery condition to a conveyor which takes it to storage. From acid and rock feeders to final conveyor the equipment is fully automatic, requiring no labor other than routine supervision.

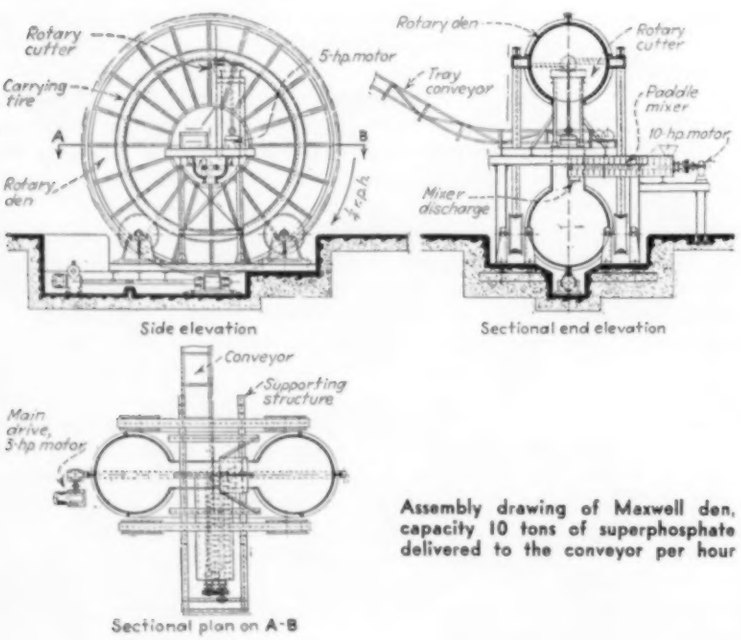
For this process, phosphate rock is ground in conventional grinding equipment to about 85 per cent through 90 mesh and is then elevated to a storage hopper which discharges to the mixer. Passing over a disk type feeder to the mixer trough, the rock meets sulphuric acid of 54-56 deg. Bé. concentration, which is supplied by a feeder mechanically synchronized with the rock feeder.



Maxwell den in operation, showing discharge side

The mixer contains two parallel, horizontal shafts, equipped with three different sorts of blades in sequence, corresponding to the conditions of the reaction. At the feed end are blades tending to retard the flow, followed in the center portion by blades having the sole function of mixing. The blades near the discharge exert a propelling action to move the now thickened slurry from the trough into the den.

The den is made of cast iron sections bolted together, resembling an enormous automobile tire set in a vertical plane. It is carried on a pair of steel tires and driven at a speed of $\frac{1}{4}$ r.p.h. by a circumferential gear, a 170,000-to-1 speed reducer and a motor. In the 10-ton per hour size (5- and 20-ton units are also built), the den has an outside diameter of 23 ft. and is driven by a 3-hp. motor. Thick slurry from the mixer is dropped into the bottom of the den, where it solidifies as it is carried upward. The shape of the den is such that the mixture is held securely in place until it reaches the top, at which point it meets a slowly revolving cutter mounted in the axis of the trough, at right angles to the rotation. The two specially shaped stainless steel blades of the cutter, which requires 5 hp. for its operation, shave off the superphosphate without the formation of lumps. Adequate mechanical ventilation is provided for the steam released during cutting. Cut material falls through a chute onto a tray conveyor which transports it to the storage pile where it is matured, prior to bagging for shipment.



Assembly drawing of Maxwell den, capacity 10 tons of superphosphate delivered to the conveyor per hour

A New Material: Ethyl Cellulose

By J. M. DE BELL

Formerly Chemical Engineer
Hercules Powder Co., Wilmington, Del.

THE LIFE HISTORY of a chemical raw material is usually divided into several well-defined periods: first, it is a scientific curiosity with no obvious application; then it attracts attention because of some unique property; then, although the initial cost of preparation is high, production usually starts for some small outlet where price is relatively unimportant; from this nucleus comes new uses, cheaper raw materials, and lower costs; and finally the material attains sufficient attraction to interest competition, and becomes a standard article of commerce. Ethyl cellulose, first proposed as a commercial material by Dr. Otto Leuchs and Dr. Leon Lilienfeld in 1912, now appears to be following this normal economic pattern.

Chemically, ethyl cellulose is the ether of cellulose and ethanol. It is marketed as a white granular powder. The procedure for manufacture is somewhat standardized. Cotton or wood cellulose of carefully controlled viscosity and moisture characteristics is treated with sodium hydroxide in water, by mastication, grinding, or steeping and pressing. The resulting alkali cellulose is then subjected to the action of an alkylating agent, usually ethyl chloride, but occasionally ethyl sulphate. The reaction lasts over a period of hours and when complete the excess reactants and byproducts are removed by distillation and washing. The ethyl cellulose which has been formed may be purified by simple washing or by solution and reprecipitation.

Physical Properties of Ethyl Cellulose as Determined by the Hercules Experiment Station:

Melting point	200–210° C.
Softening point	110–130° C.
Specific gravity	1.14
Bulking value in solution	0.1 gal. per lb.
Refractive index	1.470
Dilution ratio	Rather more favorable than cellulose esters
Moisture permeability of film	2.72×10^{-6} g. per hr. per sq. cm., per cm.*
Moisture absorption at 80 r.h.	3.4%
Light transmission	Practically complete between 2800 A° and 4000 A°
Light discoloration	About like cellulose acetate, much superior to nitrocellulose or benzyl cellulose
Breaking strength of film, unplasticized	400–600 kg. per sq. cm.
Elongation of film, unplasticized	10–20%
Dielectric constant 1,000 cycles	3.9
Power factor 1,000 cycles	.25%
Dielectric constant 60 cycles 25°	2.6
Dielectric constant 60 cycles 100°	2.9
Power factor 60 cycles 25°	.3%
Power factor 60 cycles 100°	.6%
Dielectric strength of film	1,500 volts per mil.

*Addition of 10% wax, which dissolves completely in the film, reduces this to less than 1/25 of this amount.

Early investigators all called attention to the desirable properties which are attainable with ethyl cellulose, but only recently has the significance of these properties begun to be appreciated. Ethyl cellulose of about 47 per cent ethoxy not only has the characteristic toughness of the cellulose derivatives, but also possesses low flammability with no undesirable combustion products; heat stability; light stability; extraordinary flexibility even when unplasticized and at temperatures of CO_2 "snow"; thermoplasticity; extensibility; inertness to alkalis and dilute acids; excellent miscibility with oils, waxes, and resins; and solubility in low-cost solvents.

As in the case of other common cellulose derivatives, ethyl cellulose can be furnished in various viscosities, depending on the degradation to which the cellulose has been submitted at any stage in its processing, either before or after etherification.

Wide variation of properties can be produced by comparatively small changes in the degree of substitution. For example, low substitution ethyl celluloses have high melting points and are soluble in water or dilute caustic. As the ethoxy content rises, the susceptibility to water disappears (at about 45 per cent); solubility in non-polar solvents begins to improve; and the softening point falls to a minimum at about 47 per cent ethoxy. From that point on the water resistance is better, the softening point rises, and the solubility in non-polar solvents continues. At about 50 per cent ethoxy the solubility in alcohol disappears.

Flexibility Unimpaired

Important factors in the control of ethyl cellulose are the ethoxy content; the viscosity, which is ordinarily determined in a 5 per cent solution of toluol-alcohol 80:20; ash, including complete metallic analysis if solutions are hazy; and stability of the film to continued heating. Ethyl cellulose which has been subjected to acid treatment frequently embrittles on aging, and this fault can be checked readily by observing the behavior of a film heated for several days at 110–120 deg. C. The ethyl cellulose manufactured under properly controlled conditions retains its flexibility unimpaired for at least several years.

An outstanding characteristic of ethyl cellulose is its miscibility with a wide range of solvents, resins, waxes, oils, and plasticizers, with which incorporation is often effected by heat alone. It is readily soluble in esters, chlorinated solvents, ring hydrocarbons, alcohols, and most vegetable oils; but is insoluble in petroleum hydrocarbons. It is plasticized readily by phthalates, aryl phosphates, butyl stearate, chlorinated diphenyl, and Hercolyn (hydrogenated methyl abietate); and dissolves in a wide variety of resins. Tung oil and paraffin, which by themselves are distinctly incompatible with ethyl cellulose, can be put together in specific mixtures if sufficient use is made of fatty acids, acid resins, or ester resins as a third constituent.

A great number of the uses so far developed for ethyl cellulose depend on its toughening action on oils, waxes, and resins; its flexibility; and the fact that it can often be applied by heat. Thus, it is finding application as a thermoplastic adhesive for transparent wrapping material; and as a bodying material in heat transfers to textiles (pictures, lettering, and the like trans-

ferred from a paper backing to the textile web by pressing with a hot iron).

In the plastics field progress has been relatively slow, chiefly because of the high price of the material. Since ethyl cellulose handles so excellently under heat, and since only small amounts of plasticizer are required (10-40 per cent on the cellulose ether), expansion in this field appears quite logical. Heat-extruded coverings for bare wire or cotton-covered conductors are readily accomplished even with thicknesses of the order of one mil.

The plastic properties also favor use as a pigment grinding base, since all ordinary pigments including the recalcitrant yellows and blues can be incorporated in ethyl cellulose by heat on rolls or in masticators, with no fear of combustion or undesirable color effects. The resultant chip can be incorporated in nitrocellulose lacquer or oil varnish. Ethyl cellulose in safety glass shows excellent cold break characteristics.

The lacquer field naturally emphasizes the flexibility and chemical inertness of ethyl cellulose in flexible lacquers for rubber, cloth, or paper; bronzing lacquers; and mixtures with drying oils. The last deserves special mention since ethyl cellulose can be added in general to oil varnishes to reduce greatly the drying time. Present indications are that the addition of 5 to 10 per cent of ethyl cellulose will materially reduce the drying time of oil varnishes, but special precautions have to be taken in incorporating the mixtures. With brittle miscible resins the addition of 10 per cent ethyl cellulose, with or without plasticizer, furnishes a material with toughness similar to shellac.

Ethyl cellulose appears to be an ideal textile coating material, but its use as a textile fiber appears somewhat limited at present because of its low softening point. If, instead of the usual 47 per cent ethoxy, the ethylation is carried to 50 per cent or more, the resulting ethyl cellulose has a much higher softening point and forms a textile fiber which has a marked improvement in "hand."

Besides the toughening effect previously noted, ethyl cellulose dissolved in small quantities in waxes or tarry materials, has a distinct tendency to raise the melting point, prevent crystallization, reduce shrinkage, and decrease the frangibility at low temperatures. Thus, a coal tar which is fluid at room temperature has its melting point raised to 88 deg. C. by the addition of 10 per cent ethyl cellulose; montan wax has its melting point raised from 70 deg. C. to 115 deg. C. by the addition of 30 per cent ethyl cellulose; and stearic acid, stearine pitch, tallow, and fatty acids can be "hardened" similarly.

Impregnated Metal Equipment

HIGH SILICON IRONS have been in use for equipment in the chemical industries for many years for the handling of sulphuric, nitric, acetic, phosphoric, citric and tartaric acids. And a special high silicon cast iron containing 3 to 4 per cent molybdenum has been developed that is satisfactory for use in connection with hydrochloric acid of all strengths, at all temperatures below the boiling points.

Recently Dr. Harry K. Ihrig developed, in the research department of the Globe Steel Tubes Co., a process by which it is possible to start with a cheap ferrous base metal, fabricate or machine it into almost any desired form and make it corrosion resistant by driving silicon into the iron to form an impregnation of almost any desired thickness. The case contains approximately 14 per cent silicon and is an integral part of the treated piece.

The case proper is not as ductile as the core, but the core supports the case and strengthens the article against cracking or breaking when subjected to physical stresses. The treatment does not increase the size of the article more than one to three thousandths of an inch and actually decreases the weight slightly. Also little or no distortion of the part results.

It is said that Ihrigized articles have a brinell hardness of 148-163. A tensile strength on S.A.E. 1015 standard bars gives an elastic limit about the same as an untreated bar, and the case does not crack in tension until the elastic limit is exceeded by several thousand pounds per square inch. The ultimate strength is lowered because the cracked case reduces the cross sectional area, but if calculated for the core alone it does not lower the tensile strength of the original method.

Almost all ferrous metals can be treated. Ordinary grey cast irons do not treat well because of excessive swelling which makes the case porous and soft. White irons are partially malleabilized and malleable irons have part of the graphic carbon redissolved during this treatment. It is possible to produce a fully malleabilized core if cooled slowly during the treatment. Cast steels and the S.A.E. steels can be treated satisfactorily, except the free cutting steels and high sulphur content and chromium steels. All ferrous metals should have a sulphur content less than 0.05 per cent and a chromium content of less than 0.20 per cent to produce a case of maximum resistance.

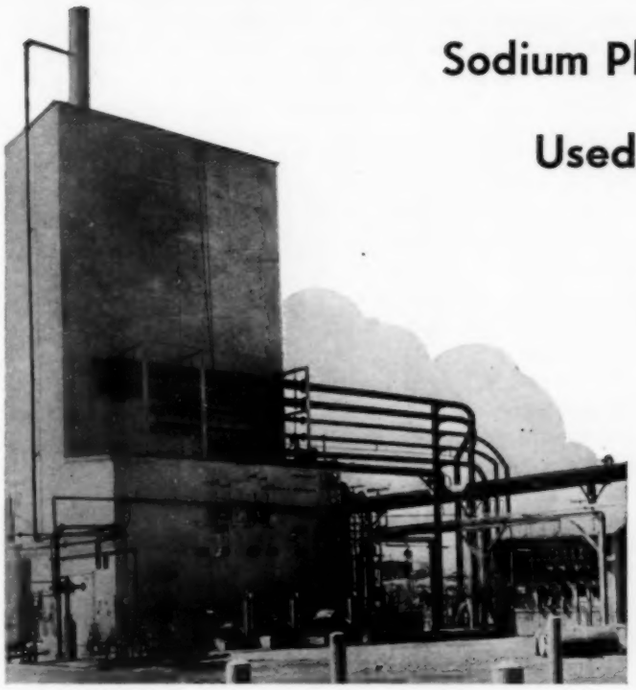
There is no practical limit to the size and shape of article that can be treated. Thin sheets cannot be economically treated because of the large ratio of surface to weight. Sheets or parts thinner than 16 gage become brittle due to the treatment extending all the way through. There are certain limitations of length and diameter of tubes which can be treated with present facilities.

Because of a slight change in size, intricate parts and those with close tolerance requirements should be treated experimentally to determine the amount of allowance necessary. Parts to be ground after Ihrigizing should be fabricated 0.010 inch oversize to allow for this final grinding to size.

Articles have shown good resistance to dilute nitric, sulphuric, hydrochloric, phosphoric and acetic acids in laboratory and service tests. All articles are tested after treatment by immersing them in hot dilute nitric acid to detect any possible flaws. A slice cut off a treated cube or bar may be boiled in dilute nitric until the entire core dissolves, leaving the case entirely untouched, it is said.

Sodium Phenolate Used in New Process for

Removal of Hydrogen Sulphide From Refinery Gas



First gas purification plant to use the new sodium phenolate process. It began operation last August at El Segundo, Calif., for the Standard Oil Co. of California

THE FIRST PLANT in the east to use the new sodium phenolate process for purification of refinery gas will be erected soon for the Atlantic Refining Co. at Philadelphia, Pa. The work will be done by the Koppers Construction Co., patentee of the process. Only one similar plant is in existence at present. That one is at El Segundo, near Los Angeles, Calif., and was completed in August, 1936, for the Standard Oil Co. of California. There, the process is being used to rid refinery gas of from 95 to 99.8 per cent of its hydrogen sulphide prior to sending it to a polymerization unit for the production of liquid hydrocarbons.

The plant to be built for the Atlantic Refining Company will be able to recover the hydrogen sulphide from 22,000,000 cu.ft. per day of refinery still gases at 225 lb. pressure. The hydrogen sulphide may be converted to sulphuric acid, and the purified still gas will be further processed for the recovery of hydrocarbons.

The purification system consists of an absorption stage and an actification stage, through which the phenolate solution is circulated continuously. This solution has an extremely high carrying capacity for hydrogen sulphide, amounting to 2,000 to 4,000 grains per gallon. As a result, it is necessary to circulate only five to ten gal. of solution per 1,000 cu.ft. of our gas. This very low circulation rate is one of the reasons for the low operating expense and the simplicity of equipment required in comparison with other liquid purification processes.

The hydrogen-sulphide laden gas enters an absorption column at the base, passes up through the twelve bubble-cap plates, countercurrent to the phenolate solution, and leaves at the top, striped of 95 per cent of its hydrogen sulphide. The solution leaving the bottom of the absorber, saturated with hydrogen sulphide with respect to the incoming gas, passes through a tubular heat exchanger to the top plate of the actifying column. It flows down over the actifier bubble-cap plates countercurrently to the stripping steam which is generated in the reboiler at the base of the tower. Sufficient indirect steam is used to effect the desired degree of actification of the solution. This, in turn, is determined by the maximum residual hydrogen sulphide desired in the exit gas.

The actified solution flows from the reboiler through the heat-exchanger shell, is further cooled in the solution cooler, and is then pumped to the fourth plate below the top of the absorber. There, the absorption cycle starts again.

Hydrogen-sulphide laden steam passes from the top of the actifier to a dephlegmator where the steam condenses. The hydrogen sulphide, which is under actifier pressure, then goes to the acid plant burner or other point of disposal. Condensate from the dephlegmator returns to the actifying column.

Fresh water is added continuously to the top plate of the absorber. The three top plates comprise, in effect, a pure-gas scrubber to recover chemicals which have been entrained or evaporated from the solution. It is necessary, at periods of several days, to replace sodium phenolate lost from the system, and a small mixing tank is provided for this purpose. The caustic soda and crude phenol used in the process are inexpensive.

Extraction and Absorption Discussed At Columbia

EDITORIAL STAFF REPORT

ON DECEMBER 28, more than 150 chemists and engineers gathered at Columbia University in New York City to attend the American Chemical Society's two-day Symposium on Extraction and Absorption. Of the fourteen papers comprising the symposium, the six which dealt with that relatively new chemical engineering operation, the continuous extraction of liquids from liquids, held the center of interest and drew the greatest amount of discussion from the audience. The other papers included seven on gas absorption and desorption and one on distillation.

The oil industry has been the pioneer in the commercial application of liquid-liquid extraction to problems of fractional separation. Hence it is not strange that most of the research and developmental work on this operation has been with respect to its application in that industry. Prof. Merrell R. Fenske and Dr. K. A. Varteressian of Pennsylvania State College presented some results from their work on the separation of methylcyclohexane and normal heptane, two hydrocarbons which are found together in gasoline fractions from most petroleums and which it is desirable to separate from each other because of their opposite effects on the octane number of the fuel. It was found that the desired separation of the hydrocarbons could be made in the course of ten extractions, using aniline as the selective solvent, whereas as many as 100 distillations would be required to get the same result. With respect to this separation, Dr. Varteressian stated, "The results of our experiments clearly set forth the increased suitability and efficiency of fractional extraction. Comparisons of the energy requirements necessary to separate these two hydrocarbons show that fractional extraction is a more efficient process and takes less energy."

A comparison of the suitabilities of spray, packed, and bubble cap towers for countercurrent liquid-liquid extraction is afforded by the two papers presented by Prof. J. C. Elgin and F. J. Appel of Princeton University and E. W. Thiele, W. H. Bahlke and M. C. Rogers of the Standard Oil Co. of Indiana. In a liquid-liquid extraction tower, the heavy liquid enters the top and the light liquid enters the bottom. In the spray type, one of the liquids, usually the one of less throughput, enters through a spray nozzle, and the drops rise or fall under the influence of gravity through the other liquid flowing through the tower in the opposite direction. "The capacity of a spray extraction tower," stated Professor Elgin, "is dependent on the rates of feed of both the dispersed and the continuous liquid phases, and especially upon the size of the drops of the former produced by the entrance nozzle. Within certain limitations, reducing the size of these drops increases greatly the capacity of the tower. For the packed tower it has been found that the capacity increases with the rate of feed of the dispersed liquid but is almost independent of that of the continuous and of the size of the drops produced at the entrance. With the type of packing material used, the capacity of this tower was intermediate between that of the spray tower when small drops were produced at the entrance and when large drops were produced." From this it was concluded that the capacity of the spray tower may be either much lower or much higher than that of the packed, depending upon the drop size used in the former. For practical purposes, a decision between the two would depend upon the cost of producing small drops in the spray tower.

Dr. Thiele reported that work done in an attempt to determine the value of the bubble cap tower for liquid-liquid extraction, gave results which showed that type of equipment to be definitely unsuitable. Three different bubble cap designs were tried but in all cases the contact of the solvent and oil appeared to be poor. This result was attributed to the low velocity of efflux of the lighter liquid from beneath the caps.

Other papers on liquid-liquid extraction included "Reflux in Solvent Extraction" by John W. Poole, Consultant, New York City, "Countercurrent Liquid-Liquid Extraction in a Packed Tower" by J. H. Rushton, University of Michigan, and "Conditions at a Liquid-Liquid Interface" by L. C. Strang, T. G. Hunter and A. W. Nash, University of Birmingham, England.

The treatment of large quantities of gases to remove a dilute constituent is a relatively new engineering problem in the gas absorption field. H. F. Johnstone and A. D. Singh of the University of Illinois presented specifications for a packed tower for the recovery of small amounts of sulphur dioxide from combustion gases. Taking all factors into consideration, the most desirable packing was found to be wooden lath grids with 1½-in. channels and with individual sections from 4 to 6 in. high. A pilot plant built on the principles outlined in the paper and operated on a sulphite-bisulphite cycle utilizing chemical regeneration, shows consistently 98 per cent efficiency on gas containing 0.3 per cent SO_2.

In discussing some new solutions for the absorption of carbon dioxide from gases, W. G. Scharmann and L. B. Gregory of the Standard Oil Co. of Louisiana pointed out that those of most importance are the organic amines.

Also included in the group of papers on gas absorption were the following: "Absorption of Gases in Packed Towers. Experiments on Solid Packing Material" by T. H. Chilton, H. R. Duffey and H. C. Vernon of E. I. du Pont de Nemours and Co.; "Desorption of Carbon Dioxide From Water in a Packed Tower" by T. K. Sherwood, F. C. Draemel and N. E. Ruckman of Massachusetts Institute of Technology; "Rate of Absorption of Carbon Dioxide by Lithium Hydroxide" by L. B. Hitchcock of the University of Virginia; "Absorption of Chlorine by Water in a Packed Tower" by R. G. Edmonds and Prof. F. W. Adams of Massachusetts Institute of Technology; "Rate of Absorption of Carbon Dioxide in a Packed Tower" by C. S. Comstock and B. F. Dodge of Yale University. J. R. Huffman and Prof. H. C. Urey of Columbia University presented a paper on "The Application of a Fractionating Column to the Separation of the Oxygen Isotopes."

Reader's VIEWS AND COMMENTS

"Toward a More Secure Peace"

To the Editor of Chem. & Met.:

Sir:—I entirely approve of your editorial which was called forth by the implications in the advertisement of World Peaceways.

It seems to me that there is a quite understandable but nevertheless most unfortunate misapprehension on the part of people who are so greatly impressed by the contributions which modern science has made to warfare. They are likely to emphasize in their own minds this aspect of the scientist's work, whereas, as a matter of fact, I doubt whether this occupies as much as one hundredth of one per cent of the interests and activities of chemists, metallurgists and others in this country. To imply that the chemical engineer, for example, is working on problems which, if he succeeds, will cause the death of a million men in the next war is as illogical as to imply that education will be the cause of more deaths in war because it will enable the operations to be conducted more intelligently, or to show a picture of a great new ocean liner with the comment, "This will carry thousands of our young men to death in the next war."

On the other hand I believe that there is a real point in these advertisements for peace which may not be construed as a criticism of the scientist or engineer. What I have in mind is the plain simple fact, which no one can deny, that modern science has made warfare more deadly. Starting from this fact, one may argue in either of two ways: first, that science is at fault and should be curbed, or second, that war has now become so dangerous that it should be avoided at almost any reasonable cost. This latter argument I believe to be sound, and perhaps it is what the advertisers have in mind.

If my interpretation is correct, I cannot but wish that the distinction between these two points of view had been brought out more clearly in the advertisement and in other similar types of publicity which I have seen.

KARL T. COMPTON
President
Massachusetts Institute of Technology

The Situation Reviewed

To the Editor of Chem. & Met.:

Sir:—I read the editorial "Toward a More Secure Peace" in your January issue. It is too bad that the well-intentioned people of World Peaceways cannot familiarize themselves with the facts and cannot think more clearly. For instance, there is no need for the "top man in his class" to go looking for new and worse poisonous material. The ones used in the last war are entirely adequate. While it is possible that some nation may have developed a more effective war gas and may have been able to keep it a secret, it is highly probable that there is no material which will take the place of the mustard gas used in the last war. Incidentally, that was first made by a Scotchman in 1865 and again by a German in 1886. The chief development since the World War has been improvement in the methods of chemical industries which would make possible the use of tons of mustard gas where pounds were used in the World War. Any nation can make mustard gas because there is no nation which is without the necessary raw materials, namely, salt, sulphur or some sulphur compounds such as the rock gypsum, and either petroleum or some material which can be fermented to give ordinary alcohol.

It is interesting that not one of the poisonous gases used during the World War was invented or discovered after the war started. Most of them had been known for many years. The one new substance developed during the War was Lewisite. This material, however, was not ready for use before the Armistice.

Returning to your editorial—I would estimate that less than 1 per cent of the chemists and chemical engineers of the United States would profit in any way from a state of war. In contrast with this small group, a very large proportion would undoubtedly suffer very serious loss. Consequently, as you say, the chemist is against war from selfish as well as humanitarian reasons.

FRANK C. WHITMORE
Dean of School of Chemistry and Physics
Pennsylvania State College

Rebuttal

To the Editor of Chem. & Met.:

Sir:—For the most part I agree with your recent editorial on the World Peaceways advertising. Of course, no one can oppose an intelligent effort toward a secure peace. No one favors such an effort more than I do, but I am not convinced that the effort of World Peaceways is more intelligent than that of many other agencies with the same purpose. It now seems to me, in the light of recent history, that hope of abolishing war in the near future is an empty illusion. I would agree that in a perfect world, war would be a "wholly silly business" but under conditions which have recently existed, I cannot agree that it is a "wholly silly business."

Here are some of my own comments on the particular World Peaceways advertisement referred to in your editorial:

1. *Picture.* By itself not objectionable.

2. *Caption.* "If he's lucky, a million men will die."—Chemists resent the fact that the picture and caption imply that their greatest and best known contributions to national defense have resulted, and will result, in increasing human misery. The most reliable information available is diametrically opposed to this conclusion.

One only has to look at the section headed "American Army Battle Casualties in World War" on page 939 of the *World Almanac* to find that for every one death due to "poison gas," 26 were killed in action by other weapons, 8 died of wounds from other weapons; 44 died of disease; 3 died of accidents off the battle field and that more deaths were due to measles than to poison gas.

From Chart No. VI of Gilchrist's "World War Casualties" (U. S. Government Printing Office, Washington, D. C., 1931) we have A.E.F. casualties and deaths:

Cause	Casualties	Deaths	Deaths per 100 Casualties
Gas	70,552	1,221	1.74
Other weapons	153,537	12,470	8.1
Totals ..	224,089	13,691	

Is it not fair to conclude that if gas had replaced all other weapons this table would have read:

Cause	Casualties	Deaths	Deaths per 100 Casualties
Gas	224 089	3,898	1.74

and that nearly 10,000 lives of American soldiers would have been saved?

But what of permanent disability? Here are the figures on that subject taken from Gilchrist's article on "The Humanity of Gas Warfare":

Permanent Disabilities in Ex-Soldiers of The A.E.F.

Nature of Deformity	Total Number	Weapons Responsible Gas	Others
Loss of 1 or more limbs	4,403	0	4,403
Loss of 1 or more joints	4,790	0	4,790
Loss of sight of 1 eye	735	29	706
Loss of sight of both eyes	44	4	40
Total	9,972	33	9,939

As to after effects of gassing, Gilchrist says (Military Surgeon November 1925):

"As the result of extensive correspondence with over 3,000 physicians in this country and Europe familiar with gases, with chemical manufacturers who have long produced gases similar to those used in the War, from a careful study of records in the Veterans Bureau, Veteran Hospitals, and from continued laboratory research conducted at the Medical Research Division, Edgewood Arsenal, we are led to believe that in a great majority of instances persons suffering from exposure to lethal concentrations of gases show no permanent resulting pathological lesions. It is true that in a minority of instances some permanent damage is done, but the damage is not wide spread and is generally confined to small areas with the fibrous tissue which is so small in amount as to hardly affect the functional efficiency of the lungs."

3. *The first four paragraphs.* Chemists resent the clear implication in these paragraphs that the study of poisonous substances is a less worthy pursuit than search for cure of cancer or prevention of infantile paralysis. This is for the following reasons:

a. Facts have been cited above which indicate that the investigation of "poison gas" will result in reducing death and permanent disability from injuries received in war.

b. Poisonous materials are used as medicines, anesthetics, antiseptics, insecticides, intermediates in the manufacture of these materials and of dyes and countless other valuable materials.

c. Investigations of poisons is a necessary part of public health work and the improvement of labor conditions.

d. Their investigation is required by law (National Defense Act, Section XIIIa) as a part of national defense. In this connection their investigation is not only necessary to provide modern weapons but is fundamental to any work in providing protective devices for our soldiers and civil population as well as to devising methods of first aid and hospital treatment for injuries from poison gas.

e. Two "poison gases" discovered by American chemists during the World War are used by the National Guard and police forces of practically all cities in the United States as manifestly more humane than bullets and clubs. Probably the use of these poison gases and of gas-masks in peace-time has saved many times the number of lives lost due to gas in the World War.

f. The two "poison gases" mentioned above are chloracetophenone and diphenylaminechlorarsine. One a lacrimator and the other a vomiting or headache producing gas. If we include with them mustard gas we have a group of gases which are very probably typical of what we have to expect from future development of gases for military purposes by any government. The principal reason for this is that their principal effects are neither lethal nor permanently incapacitating. Further, the incapacitating dose for these materials is so far below the lethal dose that investigators can test them on themselves or other human beings without fear of permanent injury.

Another reason that these gases are believed to be typical of future military developments, is that for military purposes effective gases are the primary objective. Effective gases are those which in the smallest practicable doses render the enemy incapable of resistance until they can be captured. It so happens that those gases which are effective in the smallest doses are those which produce little permanent injury.

4. *Paragraphs 5 and 6.* Chemists and chemical manufacturers resent the implication that they favor war and resort to appeals to emotion or propaganda to cause war. As American citizens they resent the subtle and ill-founded attack on the national defense, contained in this advertisement at a time when two countries are being invaded by foreign troops, a third is in the throes of civil war and armaments are being increased throughout the world.

Until such time as World Peaceways can accomplish what the State Departments of the world, the League of Nations, the Carnegie Foundation for Peace, and all the other agencies for peace have not been able to do, American chemists as citizens believe that provision for the moderate type of national defense prescribed by Congress in the National Defense Act is not only a patriotic duty and a service to the nation but also a matter of sound common sense.

5. The whole advertisement is not only offensive to American chemists but creates the impression that World Peaceways is not well informed and hence will be ineffective in accomplishing the objective. It raises questions as to the ability (or sincerity) of those who are directing its work, the use of the funds which it is collecting and of its chances of success where many other agencies have failed.

6. If World Peaceways and the magazines which have published this advertisement operate on the same principles of fair play that newspapers do, they should be willing to publish, at their own expense, an equally prominent advertisement giving in detail the facts which refute the implications of the advertisement under consideration. This should be good publicity for them and should serve to convince the public of their sound judgment, sense of fair play and clarity of thought.

The advertisement might be similar to the original with the insertion of "live" in place of "die" and with the misleading subject matter replaced by well established facts.

A CONSTANT READER

High-Grade Kaolin Not New in North Carolina

To the Editor of Chem. & Met.:

Sir:—On page 631 of the December *Chem. & Met.*, the editorial "Better Non-Metallic Raw Materials" contains two errors.

High-grade primary kaolin has been mined in western North Carolina for nearly fifty years. The T.V.A. Ceramics Division did not discover this kaolin. This division has, however, done something, with the help of various public and private agencies, in the development of a new method of refining that brings out the many excellent qualities of these particular kaolins.

The North Carolina primary kaolins occur practically free from iron and titanium. The new method of refining accordingly did not have to include removal of iron. Mica has been removed by the old process of refining for many years, and will continue to be in the new method.

The editorial speaks of "this deposit." As a matter of fact there are many known deposits of these high-grade kaolins in North Carolina. Homer J. Bryson, state geologist of North Carolina, recently estimated that upwards of 25 million tons of primary kaolin are known to be available in that state.

A refinery with a capacity of about 30 tons in 24 hours, that is using an entirely new process of production, recently has started operation on a North Carolina deposit. A second North Carolina refinery, using entirely different methods based on experience in Czechoslovakia, should be in operation late in the winter. This second refinery is understood to have a rated capacity in excess of 100 tons a day. Both are in the Spruce Pine district.

S. T. HENRY
Ceramic Research Secretary
Tennessee Valley Authority

Chemical Engineer's BOOKSHELF

AUSGEWAHLTE CHEMISCHE UNTERSUCHUNGSMETHODEN FUR DIE STAHL UND EISEN INDUSTRIE. By *Otto Niezoldi.* Published by Julius Springer, Berlin, Germany. 152 pages. Price, RM. 7.50

THE CHIEF chemist of the Rheinmetall-Borsig A. G. offers in this handbook selected analytical directions for the investigation of the materials used and produced in the iron and steel industries—steel, iron alloys, non-ferrous metals and alloys, fuels, slags and water. Culled from years of experience in the author's own laboratories, the methods are designed to furnish not only quick, simple and accurate working procedures but also instruction to the student concerning the chemical reactions involved. A useful little volume.

FLOTATION PLANT PRACTICE, Second Edition. By *Philip Rabone.* Published by Mining Publications, Ltd., London. 165 pages. Price, 10s.6d.

SO MANY important changes have been made in the flotation of gold ores during the four years which have elapsed since the first edition of this book that the author has found it necessary to rewrite this entire section. A few new machines, such as the Fagergren, the Kraut, the Geco, and some important circuits have been added, but otherwise only minor alterations have been made.

GENERAL CHEMISTRY, Third Edition. By *Harry N. Holmes.* Published by the Macmillan Co., New York City. 700 pages. Price, $3.50.

INTENDED FOR use as an elementary textbook and characterized by emphasis on the practical applications side of general chemistry, this edition follows the same general style of its predecessors. New or revised material has been added on the subjects of nuclear and atomic chemistry, radiation, food, petroleum refining, heavy hydrogen and some of the modern theoretical concepts.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Analysis of Production, Wages and Employment in the Manufacturing Industries, 1914–1933. Coordinator for Industrial Cooperation, separate group summaries for: Rubber products; paper and pulp; textiles and their products and cotton goods; mimeographed.

General Considerations on Flow of Compressible Fluids, by L. Prandtl. National Advisory Committee for Aeronautics Technical Memorandums 805; mimeographed.

Procurement of Supplies, Bid, Performance, Payment, and Patent Infringement Bonds. Army Regulations No. 5-220; 5 cents.

Recent Changes in the Painters' Trade, by Alice M. Hamilton. Department of Labor, Division of Labor Standards Bulletin No. 7; 10 cents.

Regulations No. 5, Relating to Labeling and Advertising of Distilled Spirits, under the provisions of the Federal Alcohol Administration Act, approved August 29, 1935, as amended to August 11, 1936; 10 cents.

Acute Response of Guinea Pigs to Vapors of Some New Commercial Organic Compounds —XIII Methyl Formate, by H. H. Schrenk and others. Public Health Service Reprint No. 1773; 5 cents.

Rules, Policy, and Acts. Federal Trade Commission unnumbered pamphlet, September 1, 1936; 10 cents. Rules of practice, statement of policy, and Acts of Congress from which the Commission Derives its powers. Federal Trade Commission, unnumbered document; 10 cents.

Annual Reports. The customary annual reports of the various departments, bureaus, and independent establishments, for the fiscal year ended June 30, 1936, are beginning to appear. These are available from the Superintendent of Documents at various prices.

German Minerals and Metals, by Charles Will Wright. Special Supplements Nos. 3 and 4 to Mineral Trade Notes, Bureau of Mines, entitled "Germany's Nonferrous Mineral Industries — Present Situation and Future Possibilities," and "Germany's Capacity to Produce and to Consume Metals, Fuels, and Minerals," respectively; mimeographed.

Questions and Answers on Boiler Feed-Water Conditioning, by J. F. Barkley. Bureau of Mines Question and Answer Handbook 3; 20 cents.

Contributions to the Data on Theoretical Metallurgy—VI. A Revision of the Entropies of Inorganic Substances, 1935. Bureau of Mines Bulletin 394; 10 cents.

Earth Vibrations Caused by Quarry Blasting, by F. W. Lee and others. Bureau of Mines Report of Investigations 3319; mimeographed.

Petroleum Engineering Report, Big Spring field and other fields in west Texas and southeastern New Mexico, by Charles B. Carpenter and H. B. Hill. Bureau of Mines Report of Investigations 3316; mimeographed.

Washability Studies of Coal From the Henry Ellen Bed at Acmar No. 5 Mine, Acmar, Ala., by B. W. Gandred and G. D. Coe. Bureau of Mines Report of Investigations 3315; mimeographed.

Production of Explosives in the United States During the Calendar Year 1935, by W. W. Adams and V. E. Wrenn. Bureau of Mines Report of Investigations 3317; mimeographed.

Consumption of Ferrous Scrap and Pig Iron in the United States in 1935, by R. J. Lund and H. W. Davis. Bureau of Mines Report of Investigations 3329; mimeographed.

Progress Report No. 2 on Investigation of Detachable Rock-Drill Bits, by McHenry Mosier. Bureau of Mines Information Circular 6911; mimeographed.

Some Problems of Respiratory Protection in the Petroleum Industry, With Suggestions for Their Solution, by G. M. Kintz and H. C. Fowler. Bureau of Mines Information Circular 6915; mimeographed.

Mining and Grinding Methods and Costs at the Clay City Pipe Co. Clay Mine, Urichsville, Ohio, by E. J. Lintner. Bureau of Mines Information Circular 6913; mimeographed.

Wholesale Distribution. Bureau of the Census, Census of Business, 1935, Preliminary United States Summary; mimeographed.

Sources of Information on the Properties of Metals and Alloys. Bureau of Standards Letter Circular 479; mimeographed.

List of Published Material Relating to Paint, Painting, Varnish, Lacquer, Bitumens, and Allied Subjects. Bureau of Standards Letter Circular 478; mimeographed.

Tests for Nonmetallic Protective Coatings for Underground Pipes. Bureau of Standards Letter Circular 480; mimeographed.

Improved Method for Converting Observed Skein Strength of Cotton Yarn to Strength of Specified Yarn Count, by Malcolm E. Campbell. Department of Agriculture Circular 413; 5 cents.

Comparative Moisture-Absorbing and Moisture-Retaining Capacities of Peat and Soil Mixtures, by I. C. Feustel and H. G. Byers. Department of Agriculture Technical Bulletin 532; 5 cents.

Benzol, an Efficient Screw Worm Killer. Bureau of Entomology and Plant Quarantine E-391; mimeographed.

Tobacco. Bureau of Agricultural Economics, Agricultural Outlook Charts, 1937; mimeographed.

Flow of Water Around 180-Degree Bends, by David L. Yarnell and Sherman M. Woodward. Department of Agriculture Technical Bulletin 526; 10 cents.

United States Government Manual, 1937. National Emergency Council, unnumbered loose-leaf document; $2.00.

Agricultural Exports in Relation to Land Policy. Part II of the Supplementary Report of the Land Planning Committee to the National Resources Board; 30 cents.

Provisions of Federal Law Held Unconstitutional by the Supreme Court of the United States. Library of Congress unnumbered document; 15 cents.

Uniform System of Accounts Prescribed for Public Utilities and Licensees, subject to the provisions of the Federal Power Act, effective January 1, 1937. Federal Power Commission, unnumbered document; 40 cents.

Cotton Production and Distribution, Season of 1935–36. Bureau of the Census Bulletin 173; 10 cents. Includes data on cottonseed.

Annual Report of the Tennessee Valley Authority for the Fiscal Year Ended June 30, 1936. Tennessee Valley Authority unnumbered document, 377 pages; 55 cents. Summarizes plans, research, and power contracts.

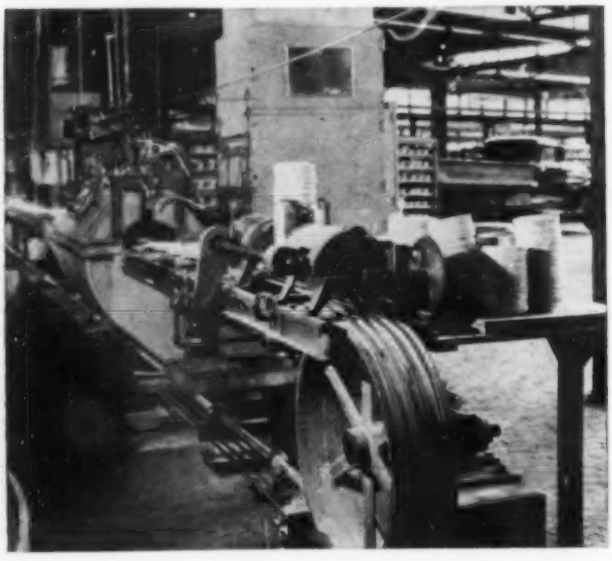
News of EQUIPMENT

Dust Precipitator

A dust recovering efficiency of 98 per cent is claimed for a new type of electrostatic dust precipitator recently developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Ten of these units, installed by the Pangborn Corp., were recently put into operation in the plant of the Homer Laughlin China Co., Newell, W. Va. Owing to their high efficiency, as compared with the 75 per cent recovery efficiency of the settling chambers previously used, the new units are expected shortly to pay for themselves out of savings.

The ten units are recovering 4 tons per week of china glaze, resulting from the daily spraying of 40,000 dozen dishes in five automatic glazing machines. The new collectors, in addition to recovering a third more glaze than the old, have saved 300 sq.ft. of floor space per machine. Operating at full capacity, each unit consumes but 75 watts. As they reach the precipitator, particles are ionized with 15,000 volts d.c. Then they are attracted to deposit plates by a 7,500-volt d.-c. field.

New self-contained electrostatic precipitator operating in conjunction with automatic glazing machine

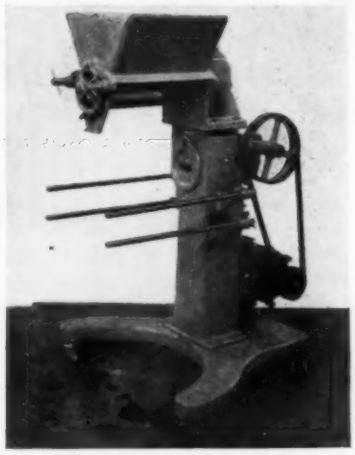


Improved Induction Motors

General Electric Co., Schenectady, N. Y., has announced a new design of riveted-frame, squirrel-cage polyphase induction motor, in frame sizes from 1 to 15 hp. at 1,800 r.p.m., which is available in a variety of electrical and mechanical modifications, incorporating improvements in stator-coil insulation, frame construction and other design features. Coordination of design has permitted a high degree of adaptability which makes it possible to meet many special requirements with the standard available line. Among the line are motors of ordinary type, splashproof motors, totally inclosed motors, explosion-proof motors for Class 1, Group D hazardous locations, vertical motors, etc.

Separator Pulley

To increase the pull possible with a magnetic separator pulley, the Stearns Magnetic Mfg. Co., 675 South 28th St., Milwaukee, Wis., has developed a new type of radiating ventilation which serves to reduce the heat around the coils. Through a system of especially designed air ducts, the air is forced into the radiating areas of the pulley by the upper belt and in turn is sucked out by the action of the return belt. This provides a continuous circulation of fresh air through the pulley, making it possible to increase the magnetic pull by 25-50 per cent over pulleys not so ventilated, according to the manufacturer. Other features include one-piece pulley castings and steel coil covers.



New oscillating granulator

New Granulator

Several accomplishments, including the production of uniform granules or nodules from damp or dry products, and coarse grinding of certain chemical powders, are claimed for a new machine recently announced by the F. J. Stokes Machine Co., Philadelphia, Pa. This machine, known as the 43-A oscillating granulator, is said to be particularly useful in conditioning filter cakes before drying. It consists of a rotor of bars which oscillate backward and forward over a screen through which the material is forced. Depending on the material and the screen, output ranges from 500 to 2,000 lb. per hour.

Among the other recent developments announced by this company is a new rotary machine for compressing tungsten pellets. It is equipped with a special pneumatic accumulator which may be adjusted so that the exerted pressure on each piece is uniform, regardless of any slight variation in the amount of material injected into the die.

New Materials

Immunity to caustics and a high degree of resistance to acids and fumes are claimed for Surfaseal Brushing Rubber, a new rubber paint announced recently by Collord, Inc., 1430 Rosedale Court, Detroit, Mich. Available in many colors, the new material can be applied to etched and sandblasted metals, concrete, brick, stone and other surfaces.

By combining Tornesit chlorinated rubber with inert pigments and suitable plasticizers and solvents, the Paper Makers Chemical Corp., Kalamazoo, Mich., has developed a new coating material for wood, metal and concrete to give resistance against acids, alkalis, fumes, gases, water and weathering. The new material, which has been given

the name of Tornalac, is applied by brushing and is said to be economical, non-flammable, water- and gas-tight, and long-lived.

Nabico Joint-Seal is the name of a new low-priced pipe cement for general joint service in pipe lines handling gas, air, hot water and steam at reasonable pressures. This compound, which is a new development of the National Boiler Improvement Co., 4100 Georgia Ave., Washington, D. C., is said to make possible easy disassembly of joints, owing to its continued elasticity.

Engineering & Licensing Corp., 40 South Clinton St., Chicago, Ill., announces the availability of Sealkote, a new protective material used to provide paper with a greater degree of resistance against grease, water, moisture and so on. This is a synthetic resin which, when combined with other materials and solvents, is used for laminating, impregnating or coating. It is available in colors as well as water white. The coating is odorless, tasteless and not especially flammable.

A new line of highly flexible phenolic resins, combining great bonding strength with resistance to friction, water, acids and alkalis, has recently been developed by General Plastics, Inc., North Tonawanda, N. Y. These new resins are designed for impregnating fabrics, woven belting, brake linings, abrasive cloth and paper, and the like.

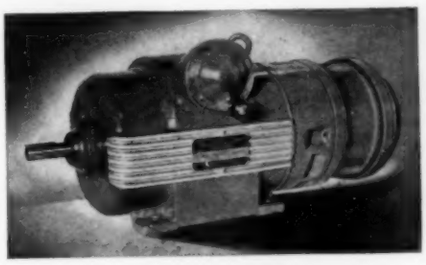
For use as a veneer and plywood adhesive, as well as for paper laminating and coating, and other applications, the Laucks Laboratories, Inc., 314 Maritime Bldg., Seattle, Wash., has developed a new thermoplastic synthetic resin based on a newly discovered reaction of zinc chloride, urea and formaldehyde. The material is transparent and colorless and sets up in a few seconds at 225 deg. F.

Thompson & Co., P. O. Box 6757, Pittsburgh, Pa., has announced the availability of the Synhibit process for protecting structural steel. The process consists in the removal of rust and loosely adhering mill scale by wire brushing, followed by the application of a special inhibitor which removes any remaining rust, including that under the edges of closely adhering mill scale. The inhibitor treatment is followed by the application of a special primer and then a finish coat. Both the primer and finish coat employ a synthetic vehicle.

Acitrol 100 is a new chemical inhibitor for use in steel pickling which is said to differentiate between the productive and non-productive galvanic couples present in a pickling solution. It has high dielectric strength, high cathodic affinity and freedom from breakdown, according to the manufacturer, E. F. Houghton & Co., 240 West Somerset St., Philadelphia, Pa.

Variable Speed Transmission

A new straight-line, self-contained, splash-lubricated, variable-speed transmission which uses no belts, chains, cams, pumps, ratchets or pressure devices, and which combines the function of speed reducer, infinite speed variator and load-limiting device, has been announced by Graham Transmissions, Springfield, Vt. The driving motor is connected to a carrier or cage which retains three tapered rollers kept in intimate contact under pressure with a ring surrounding them. This ring is not permitted to revolve but can be moved laterally by the speed adjustment



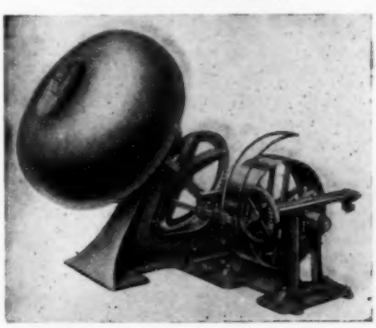
Variable speed transmission

mechanism. The carrier, revolving at motor speed, rotates the rollers in planet fashion at motor speed times the ratio of ring and roller diameter at the point of contact. These rollers carry planet pinions which mesh with an internal gear, the latter being connected to the output shaft. By moving the fixed ring along the tapered rollers, infinite speed variation, from positive through zero to reverse, is obtainable. Standard sizes range from 1½ to 7½ hp.

Process Equipment

Recent developments announced by the Patterson Foundry & Machine Co., East Liverpool, Ohio, include a new dissolver and a new type of mixer. The dissolver, which is intended for cutting cotton, dissolving cellulose acetate and resins of all kinds, as well as for the dispersion of pigments in vehicles, is built in plain and jacketed types, and also for internal working pressures up to 100 lb. per square inch. It is made in various materials of construction and for handling any desired viscosity. Explosion hazards are said to have been eliminated and power consumption reduced to the minimum.

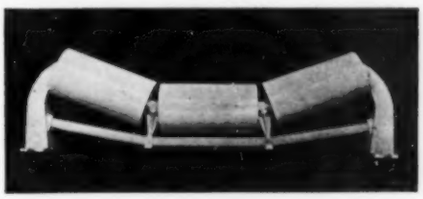
New bowl type mixer



The new mixer, which is built in eight sizes with bowls ranging from 18 to 72 in. in diameter and capacities from 1 to 75 cu. ft., is similar to a drug mill in appearance. The mixer bowl, shown in the accompanying illustration, revolves and within it are balls of large diameter which roll around its inner periphery. Machines of this type are said to make possible more than usual intimacy of mixing and are suitable for mixing and blending dyestuffs, colors and chemicals. Without the balls, they may be used for coating and other pharmaceutical work. Various materials of construction are available.

Truss-Frame Carrier

Lightness and extreme rigidity are features of a new truss-frame belt conveyor carrier, employing sealed ball bearings, recently announced by the Stephens-Adamson Mfg. Co., Aurora, Ill. This carrier is of the three-roll-in-line design, with outer rollers inclined to give the belt a 20-deg. trough. The rollers are of 5 in. diameter steel tubing,



Truss-frame belt conveyor carrier

with ends smoothly rounded to prevent belt fraying. Renewable cartridge-type ball bearings are used. Owing to the truss design, the load is carried by a tension rod, instead of depending upon the stiffness of a heavy cross member.

New Mixers

Several new developments in portable mixers have been announced by the Mixing Equipment Co., Rochester, N. Y. Among these is the Model L laboratory mixer, powered with a 1/30 hp. totally-inclosed, air-jacketed, fan-cooled motor. Shaft and propeller are supplied either in stainless steel or Monel metal. An adjustment is provided whereby the shaft length can be varied 5 in. This mixer can be equipped with a folding propeller which opens by centrifugal force after insertion through a small opening.

This company is now prepared to

supply production-size portable mixers with both air-jacketed and explosion-proof, air-jacketed motors. Both types employ a fan to draw air from the top of the motor, down through a jacket around the motor housing. The air, having cooled the motor, is then ejected downward toward the vessel to which the mixer is attached, in such fashion as to blow steam, fumes or dust away from the motor. The explosion-proof motor used with the explosion-proof type carries Underwriters approval for use in Group 1, Class D hazardous locations.

Equipment Briefs

Two new psychrometers have recently been announced by the G. M. Manufacturing Co., P. O. Box 151, Madison Square Sta., New York City. One of these is a fan psychrometer comprising in combination a wet and dry bulb thermometer and a small hand-operated fan to give the desired movement of air past the wet bulb. A belt and brackets are available for attaching the psychrometer to the operator's body for portable use. The company has also introduced a swing psychrometer made in both a non-folding and a folding design.

For the production of hot water by mixing steam and cold water, the Sarco Co., 183 Madison Ave., New York City, has developed a new mixer which incorporates a three-way valve, a water injector and a temperature regulator in one compact unit. Sizes range from ½ to 2 in. and capacities, at 25 lb. steam pressure, from 80 to 460 g.p.h.

For use in both industrial and comfort air conditioning installations, H. J. Kaufman, 13215 Roselawn Ave., Detroit, Mich., has announced a new line of dehydrating cabinets in which air is dried by chemical means. Air passed through the cabinet comes in contact first with a dehydrating solution and then with solid dehydrating material. Dry dehydrating material is occasionally fed into the top of the cabinet and after absorbing moisture from the air, goes into solution and flows downward through the apparatus to waste. If desired, cooling coils can be supplied for removing the equivalent latent heat of the water vapor condensed. Capacities range from 200 to 500 c.f.m.

A plastic ramming mix and a plastic cement produced from andalusite-base mullite have been developed by ceramic engineers of the Champion Spark Plug Co. and are available through the Detroit Electric Furnace Co., 825 West Elizabeth St., Detroit, Mich. These materials, especially intended for high-temperature melting furnaces, are similar chemically, but differ in screen size, the ramming mix being of coarser texture.

Unusually high efficiency, combined with unity power factor at full load and leading power factors up to 40 per cent at no load, are claimed for the new Noel Speedarc welder recently announced by the Ideal Electric & Mfg. Co., Mansfield, Ohio. This company's welders are said to be the only ones capable of supplying power factor correction. The lower power bills resulting from their use are said often to absorb the entire cost of the welder within two years. Other advantages include a very fast arc, low operating cost and a dual control system.

MANUFACTURERS' LATEST PUBLICATIONS

Alloys. International Nickel Co., 67 Wall St., New York City—48-page book describing the use of Monel metal and other nonferrous nickel alloys in the field of engineering applications, covering corrosion resistance and other properties.

Alloys. Manganese Steel Forge Co., Richmond St. & Castor Ave., Philadelphia, Pa.—Bulletin R-1—27-page booklet on this company's manganese steel products including forgings, pressings, plate, wire and rod products, bars and shapes.

Boilers. Edge Moor Iron Works, Edge Moor, Del.—Catalog 102—20 pages describing various types of steam generator offered by this company. Also covers waste heat boilers and preheaters, together with typical installations.

Chains. Chain Belt Co., Milwaukee, Wis.—Leaflets briefly describing this company's Z-metal chains for materials handling in process industries; Griplock construction for such chains; and roller chains for power transmission.

Chemicals. E. I. du Pont de Nemours & Co., Wilmington, Del.—16-page booklet describing properties and uses of this company's new plastic material, "Pontalite." Also bulletins issued by Grasselli Chemicals Department, covering control of pickling solutions; and a process for bright zinc plating.

Chemicals. A. R. Maas Chemical Co., 308 East 8th St., Los Angeles, Calif.—Booklets listing and describing this company's phosphates and industrial chemicals; and photographic chemicals.

Chemicals. National Ammonia Division, E. I. du Pont de Nemours & Co., Frankford, Philadelphia, Pa.—Bulletin 67—28 pages completely descriptive of the use of ammonia in petroleum refining.

Compressors. Clark Bros. Co., Olean, N. Y.—Catalog presenting this company's line of stationary compressors for engine or electric drive, portable engine-driven compressors, oil field engines, and natural gas engines for generator drive.

Equipment. R. C. Stanhope, Inc., 101 West 31st St., New York City—Catalog 37—32-page catalog and list covering 2,000 new and used pieces of process equipment.

Fans. National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich.—20-page Standard Test Code for disk and propeller fans, centrifugal fans and blowers, prepared by National Association of Fan Manufacturers and American Society of Heating and Ventilating Engineers; price 25 cents. Also 4-page chart giving fair general comparison of various commercial ventilating fan sizes.

Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin HD 1236—4 pages on a number of types of electric combustion tube furnace.

Instruments. Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa.—Bulletin G-11—4 pages describing in some detail this company's new "Balancer" for automatic load-compensated control of such functions as temperature and pressure.

Instruments. Foxboro Co., Foxboro, Mass.—Bulletin 188-1—40-page bulletin discussing instruments and application methods for humidity control in industrial drying and processing operations.

Instruments. Julien P. Friez & Sons, Baltimore, Md.—4 pages describing Model FD standard recorders for water level, discussing recent improvements in these instruments.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Catalog 699D—24 pages, plus price list, covering this company's wide range of thermometers, hydrometers, viscosimeters and other instruments for the testing of petroleum products.

Materials Handling. Cleveland Crane & Engineering Co., Wickliffe, Ohio—Form G-436—6-page leaflet illustrating and briefly describing unusual applications of this company's overhead materials handling equipment.

Materials Handling. Link-Belt Co., 300 West Pershing Road, Chicago, Ill.—Book No. 1795—12 pages describing the advantages of this company's Speed-o-Matic hydraulic power control for power shovels, draglines and cranes.

Mixers. Patterson Foundry & Machine Co., East Liverpool, Ohio—Catalog 375—72 pages with descriptions and specifications covering a wide range of mixing and agitating equipment produced by this company.

Ovens. Gehnrich Corp., Skillman Ave. and 35th St., Long Island City, N. Y.—Bulletin 102—4-page booklet briefly describing this company's ovens, dryers and air heaters for industrial baking, drying and heat treating operations.

Power Transmission. Link-Belt Co., 519 North Holmes Ave., Indianapolis, Ind.—Data Book No. 125—96-page 1936 edition of this company's data book on Silverstreak silent chain drives in capacities from fractional to 2,000 hp.

Pulverizers. Raymond Bros. Impact Pulverizer Co., 1302 North Branch St., Chicago, Ill.—Bulletin 28—4 pages on applications of this company's roller mills equipped with "whizzer" type separators.

Pulverizers. Whiting Corp., Harvey, Ill.—Bulletin 15—48-page catalog on construction and applications of pulverizers for fine grinding, also covering pneumatic conveying equipment, fuel burners and auxiliary equipment.

Pumps. American Manganese Steel Co., Chicago Heights, Ill.—20-page catalog describing this company's complete line of standard and "counterflow" manganese steel pumps and pump fittings.

Pumps. Beach-Russ Co., 50 Church St., New York City—Bulletin 70—4 pages on this company's single-stage rotary high-vacuum pumps for dry or semi-wet work.

Pumps. Byron Jackson Co., Berkeley, Calif.—Bulletin 366—Striking 40-page book with descriptions and useful engineering information on this company's deep well turbine pumps.

Refractories. General Refractories Co., Philadelphia, Pa.—8-page reprint of a National Lime Association paper by R. P. Heuer and L. J. Trostel on refractories used in lime burning.

Rubber Goods. Mechanical Rubber Goods Div., B. F. Goodrich Co., Akron, Ohio—27-page catalog on mechanical rubber goods, including transmission belts, conveyor belts, hose, nozzles and fittings, and miscellaneous items.

Threaders. Oster Mfg. Co., 2057 East 61st Place, Cleveland, Ohio—Loose-leaf catalog of bulletins on pipe-threading equipment and machinery, including torch cutting machines for preparing pipe ends for welding.

Turbines. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1181—20 pages on high-back-pressure, non-condensing turbines for byproduct power production.

Valves. Kennedy Valve Mfg. Co., Elmira, N. Y.—Bulletin 47—Leaflet describing and listing features of design of this company's new iron-body wedge-gate valves.

Welding. Lincoln Electric Co., Cleveland, Ohio—Bulletins 314, 315 and 316—Each 4 pages covering, respectively, 45-200 amp. welders, 200-600 amp. a.-c. motor-driven welders and 200-600 amp. d.-c. motor-driven welders.

Welding. Linde Air Products Co., 30 East 42d St., New York City—Form 2367—30 pages reviewing recent accomplishments in Lindewelding of pipe lines; also form 3019, 8 pages on the use of the oxygen lance.

Your Plant NOTEBOOK

SUCTION REMOVAL OF SETTLER SLUDGES

By W. B. Marshall

Engineer, Chain Belt Co.
Milwaukee, Wisconsin

A NEW TYPE of settling tank which uses a "vacuum cleaner" method of sludge removal is being operated with considerable success in a large pulp and paper mill in Wisconsin. In this particular installation the system is being used to recover settled pulp stock from white water, but its principle and design are such that it should find application in other process industries which involve settling operations.

The apparatus differs from the conventional settler and thickener chiefly in the fact that the underflow or sludge is drawn out through two traveling suction nozzles rather than raked to a stationary outlet in the bottom of the tank. It has been found that this method offers an advantage over scrapers and rakes in that there is less tendency to stir up the sludge, and consequently more effective concentration is obtained. Also, since there is no abrasion of the tank bottom, contamination and discoloration from that source are eliminated entirely.

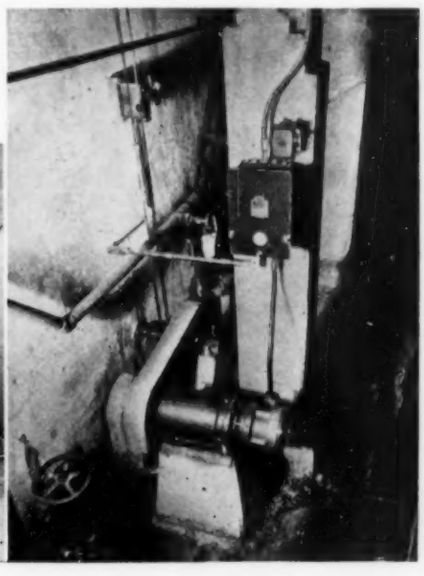
The action of the apparatus can best be described as similar to a vacuum cleaning of the floor of the tank. Two suction nozzles, each of tank width, are connected to the extremities of two parallel roller racks which run on the floor of the tank. The racks are driven back and forth by two sprocket wheels mounted on a fixed central shaft which extends out through a stuffing box in the side of the tank to a gear motor drive. Since the racks are slightly longer than half the length of the tank, the two nozzles are so spaced that together they cover the entire tank floor each time the racks are driven the length of their tracks. By means of a limit switch mechanism connected with the motor starter, the rotation of the sprocket shaft is reversed when the rack reaches either end of the tank.

Flexible rubber hoses connect the two suction nozzles to outlet pipes which lead through the tank wall to vacuum pumps located nearby. The nozzles themselves are constructed slightly higher at the middle where the suction hose is connected, and from that point taper down gradually to each end. This design, together with the distribution of the openings on the under side, gives uniform suction over the entire nozzle length.

The feed inlet and clearwater outlet of the unit are tank-width launders located at opposite ends of the tank. Between them a baffle is installed which tends to equalize the distribution of settled solids deposited in the two areas covered by the nozzles. In the case of pulp stock, the settled material is so fine and easily distributed that it does not settle in a pile at any one point, but tends to form a uniform "blanket" on the tank bottom.

Using this method of sludge removal, the aforementioned paper mill is clarifying its white water from about 13 lb. of dry stock per 1,000 gal. of water down to $\frac{3}{4}$ lb. or less of dry solids per 1,000 gal. of water. The clarified water is almost always sparkling clear. The settled stock, which contains about 60 per cent clay and 40 per cent wood fibers, is removed at a consistency of about 300 lb. of dry solids per 1,000 gal. The rate of draw-off is ordinarily 150 gal. per min.

The advantages of the apparatus for paper stock reclamation have been found to be as follows: (1) lower first cost and greater efficiency of clarification in comparison with vacuum filters; (2) less loss of stock than in ordinary settling tanks; (3) simplicity of design which allows all submerged parts to be made of non-corrosive bronze at moderate cost; and (4) simple construction with a minimum number of wearing and deteriorating parts, which results in almost complete absence of maintenance requirements.



Rectangular settling tank showing suction sludge removal unit and electrical control

Chemical Engineering NEWS

Electrochemists Arrange For Spring Meeting

ARRANGEMENTS are well under way for the spring meeting of The Electrochemical Society, Inc., which will be held at the Hotel Benjamin Franklin, Philadelphia, April 28 to May 1. Present plans call for two main sessions. The morning of April 29 will be devoted to a symposium on "Electrochemical Methods in Biology." This will be in charge of Dr. Duncan A. MacInnes of the Rockefeller Institute for Medical Research. On May 1, a symposium on "Industrial Catalysis" will be presided over by Dr. Carleton Ellis of Montclair, N. J. For the latter symposium, papers have already been promised from Dr. Max Bodenstein of Germany, P. H. Emmett, U. S. Bureau of Chemistry and Soils; O. B. J. Fraser, International Nickel Co.; P. K. Frolich, Standard Oil Development Corp.; B. S. Hopkins, University of Illinois; V. N. Ipatieff, Universal Oil Products Co.; H. S. Taylor, Princeton University, and H. J. Schumacher, Frankfurt University.

The morning of April 30 will be given over to plant visits and in the afternoon, members and guests are invited to inspect the Franklin Institute, including the Planetarium. The annual dinner dance will be held in the evening.

Industry Gives Support to Chemists' Club Library

LEADING chemical firms are contributing to the support of the Library of the Chemists' Club in New York as a result of a campaign now in progress to raise additional funds to modernize and bring up to date this valuable Library.

The Library has been supported by the members of The Chemists' Club but in view of the heavy expense involved and the value of the Library to the chemical industry as a whole, the industry has recently been asked to share in its support and many of the leading chemical firms have responded generously to this request.

The technical staffs of most of the chemical companies have made use of its facilities and know the thoroughness with which the Library covers the chemical field. Those at a distance appreciate its prompt photostat service. In addition to the 40,000 books and reference works on chemical and technical subjects, which are constantly being augmented by current publications, it has bound volumes of many United States and foreign technical periodicals not found in any other library in this country.

For more than twenty-five years, the Library has been open without cost to the chemical industry and the general public. Contributions from firms in the industry during the last few years have helped defray expenses but unfortunately it has been necessary to curtail the purchase of new volumes and even to discontinue some subscriptions.

Johns Hopkins To Celebrate Engineering Progress

TWENTY-FIVE years of research and advanced instruction as a top rank institution will be celebrated by the Johns Hopkins School of Engineering during the three days of February 19-22. Technical sessions and an extensive exhibition will precede the principal event, which is to be an address by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, at the sixty-first Commemoration Day exercises of the University on the morning of February 22.

Under the supervision of Dr. Wilbert J. Huff, professor of gas engineering, a display of interesting material in the field of chemical engineering is being arranged for the exhibition. Experiments with the combustion of gases, the analysis of oils, and new forms of gas analysis apparatus developed at the University will be demonstrated. It is expected that a model of a coke oven battery and a gas refrigeration system will be on view.

Professor Huff will discuss some of the research problems of his department in a paper to be read at the conference period on February 20.

Considerable attention has been devoted to the development of a new method of instruction for undergraduate and graduate students of chemical engineering in the School. During the past year a complete reorganization of courses has been effected and additional ones have been provided with a view to integrating engineering problems within the whole field of chemical investigation. Advanced standards of work in the preliminary courses assure the thorough fundamental training of candidates for chemical engineering degrees.

Electrodeposition Sessions Scheduled for London

THE First International Electrodeposition Conference, organized by the Electrodepositors Technical Society will be held in London, England, March 3-4. The sessions will be held at British Industries House and the general topics to be discussed are: "Electrodeposition Practice Abroad," "Electrodeposition of Base Metals," "The Properties of Electrodeposits," and "Electrodeposition of Precious Metals."

Americans who will submit papers include: Prof. Arthur Phillips, Yale University; Walter Meyer, General Electric Co., Bridgeport, Conn.; K. Schumpelt, Baker & Co., Inc., Newark, N. J.; Gustaf Soderberg, Udylite Co., Detroit, Mich., Prof. A. K. Graham, University of Pennsylvania; B. Egeberg, International Silver Co., Meriden, Conn.; Frank C. Mesle, Oneida, Ltd., Oneida, N. Y., and George B. Hogaboom, Hanson, Van Winkle, Munning Co., Matawan, N. J.

Alkali Export Association Formed in California

THE California Alkali Export Association has filed papers with the Federal Trade Commission, under the Export Trade Act for exporting soda ash, sodium products and other derivatives of soda ash. The association will maintain an office at Los Angeles.

Officers of the association are: D. B. Scott, president; George E. White, secretary; and J. R. Blair, treasurer. Members are: American Potash & Chemical Corp., Los Angeles; Pacific Alkali Co., Los Angeles; and West End Chemical Co., Oakland, Calif.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

MESSAGES from the President to Congress or the American people are always important. January provides three such, the annual message at the opening of Congress, the budget message, and the inaugural address. But none of these, nor all three together, will present a real picture of the President's plans for 1937. Perhaps it is fair to say that these plans are not anywhere recorded as an orderly list of legislative and administrative proposals. President Roosevelt does not work in that pre-planned fashion, though supposedly the greatest Planner of modern times.

It is evident what some of the major objectives of the President and of Congressional New Deal leaders are to be. The roads likely to be chosen for reaching all of these objectives are, however, not on any map. In some cases the land can not even be surveyed and a route planned until a few more Supreme Court decisions are available. It is known, however, that the transit of the New Deal will be at all times sighted on social objectives. One might even say that the only chain of the administration surveyors is calibrated in human-interest or good-neighbor units.

Labor First

Labor serving objectives will come first in all planning. The reemployment problems are, however, decidedly secondary. Reform of employment standards is now the objective, i.e., betterment in working and living standards, not merely getting a man a job.

Under the prevailing philosophy of Washington one would suppose that the chemical industry, which pays wages far above average and works shorter hours than most others, would be almost exempt from critcism. However, such philosophy of relativity is not acceptable in official circles. As previously pointed out in the pages of *Chem. and Met.* officials in high positions criticize the chemical industry just as sharply as others, because labor does not get as large a slice of gross income as these reformers say the workers are entitled to.

It is quite evident that the plan of labor reform is based in substantial measure on the idea of making workers dissatisfied with their present conditions of employment. No official would admit this. But it is the practice, seemingly deliberate, and only a step short of the even-less-readily-admitted demand for complete unionization of business. It is not at all sure that the President likes these two weapons which his close advisers choose.

The act which established National Labor Relations Board is on trial in the courts. Until the Supreme Court rules as to its constitutionality the N.L.R.B. will remain the keystone of Administration labor planning. Should the Court refuse to approve that technique of Federal influence on labor matters, great confusion is sure to follow, much greater than that succeeding the demise of the Blue Eagle. No one knows not even Administration leaders, what steps would then be taken to aid and advance labor standards.

Pending further announcements of formal plans, the following types of legislation deserve thoughtful consideration by every business executive:

1. A 30-hour week bill. This is highly improbable as such, but furnishes splendid trading basis.

2. The Federal incorporation bill (O'Mahoney), veteran of many Congresses now directly backed by A. F. of L. When labor backs this bill Washington knows that they are unable to devise a better more direct way to attack the stronghold which they wish to occupy. This time it may pass, but labor would much prefer a direct bill, such as—

3. Minimum wage and maximum hour standards defined by Congress. These may take a general form or be by single industry (a la Guffey for coal).

4. A tightening of the Walsh-Healey Act to give wider application on sales to the Government.

5. Bills to emphasize the importance of unionization, supplementing and strengthening the present N.L.R.B. This effort probably has strongest support of the President.

6. More emphasis on social security. A. F. of L. will ask that all payroll taxes be put on the employer, but will probably not get this favor this year. Watch out for it next Presidential-campaign year!

7. Further aggressive study of anti-strike methods. The La Follette committee will probably get money to prosecute its "investigations of guns and gas."

Anti-Trust Trends

Proposals regarding anti-trust legislation range all the way from outright repeal to rigid enforcement. Neither extreme practice should be expected. Continued enforcement effort by occasional important suits originating in the Department of Justice will not be changed, even if some of the major simplifications now proposed should be enacted by Congress.

T.V.A. Reports

The most significant general report yet released by T.V.A. is its 377 page annual report to the President and Congress covering the fiscal year ending June 30 last. This document presented at the year end brings a resume of fundamental philosophy and principles, as well as much detailed information regarding the Authority activities, even a personnel list itemized down to individuals getting as little as $1 per hour. The inclusion of this personnel information is in accordance with Congressional act passed some years ago which sought to eliminate T.V.A. from politics, and to give a full "gold fish bowl" status to its activities.

The fertilizer section of the report outlines the general policy and reports briefly some of the technical achievements, most of which have been even more fully reported in the pages of *Chem. and Met.* recently. By implication, the report suggests that there is no plan contemplated for commercial manufacture of fertilizer or other industrial materials under Authority direction. It is well known in Washington, however, that great pressure is being brought to bear by the American Farm Bureau Federation to have commercial operations so carried on in the Valley.

The A.F.B.F. convention resolution of December pledging "support of the Tennessee Valley Authority's fertilizer program" has ominous implications to fertilizer men. However, neither the Farm Bureau nor the Authority offices are willing to admit any intention to put this government corporation into commercial manufacture *for sale*. That possibility may, however, become an issue in Congress shortly. The Authority, though probably privately willing, must for court-defense reasons carefully consider the hazards of unconstitutionality involved. Observers in Washington continue to wonder how the obvious desire to subsidize Government manufacture can be reconciled with this important precautionary attitude.

Among the other phases of the

T.V.A. report of interest to chemical engineers is the full text of the power contract made between the Authority and Monsanto Chemical Co. This contract not only discloses the power rates charged, but also gives the first adequate picture of the terms under which the Authority is willing to lend its influence for the stimulation of new electro-chemical and electro-thermal enterprises in its area.

I.C.C. Rulings

Railroads were denied permission to continue the "emergency" freight rates, by a decision of December 18 of I.C.C.. This at least temporarily restores previously prevailing lower basic rates. But the long run implication will not be known until the further findings of the Commission have been announced on new rate schedules still pending. Some of these schedules would give all or more increase to the carriers than the old surcharges.

Another benefit to chemical shippers is evidenced in permits to construct 100 additional welded tank cars for hauling liquified petroleum gas. Thus the previous "experimental" use of welding is substantially extended.

Industrial shippers will find still further comfort in another clean cut ruling of the Commission during December. This gives formal notice that the Commission will not require corporate owner-users of trucks handling their own goods to comply with any of the provisions of the "Motor Carrier Act" except those which relate to the maximum hours of driver service and safety of equipment and operation. Hitherto there has been some question as to whether owner-used trucks engaged in interstate movement of goods would have to comply with elaborate regulations.

A still further evidence of the "reasonableness of regulations" fixed under motor carrier laws pleased chemical observers. It is the decision of last October that certain explosives permissible for handling in trucks may also be handled in semi-trailers, including: Fireworks, cordeau detonant, delay electric igniters, electric squibs, fuse lighters, instantaneous fuse, safety squibs, small-arms ammunition, small arms primers.

Internal Reorganization Of Bureau of Mines

INTERNAL reorganization of the Bureau of Mines has now become effective. Under this plan the Bureau is divided into four equally ranking branches: Technologic branch, Economics and Statistics branch, Health and Safety branch, and administrative branch. The Technologic branch is divided into the following divisions: Coal, Mining, Metallurgical, Petroleum and Natural Gas, Non-metals and Explosives.

Perkin Medal Awarded To Thomas Midgley, Jr.

AT a joint meeting of the American Section of the Society and the American Chemical Society on Jan. 8, Thomas Midgley, Jr. of the Ethyl Gasoline Corp., was presented with the 1937 Perkin Medal of the Society of Chemical Industry. The medal is awarded annually for the most valuable work in applied chemistry, and was given to Dr. Midgley for his outstanding accomplishments in the development of anti-knock motor fuels and safe refrigerants. James G. Vail, Chairman of the American Section, presided over the meeting, which was held at the Chemists' Club in New York City. The program included a talk on the accomplishments of the medalist by Robert E. Wilson of the Pan American Petroleum and Transport Co., presentation of the medal by Marston T. Bogert of Columbia University, and the medal address, "From the Periodic Table to Production," by Thomas Midgley, Jr. A dinner in honor of Dr. Midgley was held at the Chemists' Club immediately preceding the meeting.

Thomas Midgley, Jr.

Lincoln Electric Sponsors Research Foundation

SPURRED by a dual desire to stimulate scientific development in the arc welding field, and to honor the pioneer work of its president in promoting arc welding and perfecting and developing arc welding equipment and electrodes, The Lincoln Electric Co., Cleveland, Ohio, has just completed long contemplated plans for establishing a Fund and Foundation to encourage study and research for benefit of the industry. This new fund, which was voted by directors of the company at the turn of the year, has been named "The James F. Lincoln Arc Welding Foundation."

Principal direction of the Foundation's work will be given by Dr. E. E. Dreese, Chairman of the Department of Electrical Engineering of The Ohio State University.

Discoverer of Glycerine Honored on Anniversary

FIFTEEN outstanding American scientific, technical and industrial associations united on Dec. 19 in a formal tribute to the memory of the discoverer of glycerine, the Swedish pioneer in the fields of chemistry and pharmacy, Dr. Karl Wilhelm Scheele. The occasion was the anniversary of Dr. Scheele's birth 194 years ago.

A congratulatory message to Crown Prince Gustaf Adolf, as head of the Royal Academy of Sciences in Sweden, was cabled by the 15 American groups, describing Dr. Scheele's isolation of glycerine in 1779 as a "significant contribution to modern life."

Although Dr. Schele is remembered especially for his discovery of glycerine, which now plays an extensive and varied role in modern medicine, industry and every day life, he is also credited with the isolation and analysis of many other substances unknown before his day, including chlorine.

Memorial Exercises for Father Nieuwland

ON January 10, memorial exercises were held at the University of Notre Dame for Rev. Julius Arthur Nieuwland. The exercises were held in Washington Hall with Rev. Francis J. Wenninger, CSC., Dean of the College of Science presiding. Dr. Marcus W. Lyon, Jr., past president, Indiana Academy of Science, spoke on "Father Nieuwland the Botanist" and William S. Calcott, director, the Jackson Laboratories, E. I. duPont de Nemours & Co., spoke on "Father Nieuwland the Chemist." Other speakers included Prof. Arthur Haas, University of Notre Dame, Brother Marie Victorin, University of Montreal, Prof. George D. Birkhoff, Harvard University and Prof. Hugh S. Taylor, Princeton University.

Father Nieuwland, who was William H. Nichols medalist in 1935, died suddenly on June 11, 1936, while on a visit to Washington, D. C.

British Chemical Engineering Made Progress in 1936

FROM OUR LONDON CORRESPONDENT

BRITISH chemical engineering has had a year of progressive activity. Accumulated results of research, stimulated in anticipation or as a result of the Chemical Engineering Congress of the World Power Conference held in London during the summer of 1936 and by a generally wider appreciation of the value of research applied to industry, has done much to promote a steady modernization at chemical works and in the chemical-using industries. In addition, a certain amount of activity has naturally arisen from the re-armament program and from the need for making Britain less dependent upon external supplies of certain essential commodities.

Sulphuric acid production increased nearly 10 per cent during the first half of 1936, by comparison with the same period in the preceding year. Statistics for the complete year are not yet available. Progress is also indicated by the fact that many chemicals hitherto imported, were made at British works for the first time, one notable instance being the manufacture of sodium chlorate by an electrolytic process at the works of the Staveley Coal & Iron Co.

New plants of large capacity which came into operation during 1936 included a sulphuric acid plant at Kings Lynn, a superphosphate plant at Avonmouth, and numerous byproduct recovery installations subsidiary to the production of smokeless fuel, metallurgical coke and coal gas.

The sulphuric acid plant at Kings Lynn was built at the works of the West Norfolk Farmers' Manure & Chemical Co-operative Co., who use the acid mainly for making superphosphate. The performance of this plant will be followed with great interest, because the design is novel to Britain. The output of acid is 90 tons per day leaving the chambers at a strengh of 54° Bé., and 40 tons of pyrites are roasted to produce the necessary sulphur gases. The plant is built on the patented Moritz system, with high chambers and low communications, and a production of 20 kilos of 53-54° Bé. acid per cubic metre of chamber is easily obtained without any so-called "intensive working." The space occupied by the lead chambers, one Glover tower and two Gay-Lussacs, in plan, is only 135 ft. x 47 ft. The discharge to the atmosphere shows less than 1 grain per cubic foot, whereas British Alkali, etc., Works Regulations permit 4 grains per cubic foot. The electrostatic precipitation of dust in the sulphur gases from the pyrites roasters ensures the production of a clear acid and absolutely avoids any possibility of choking the Glover and Gay-Lussac towers.

Plants have been erected in London to utilise waste gases, containing sulphuretted hydrogen up to 25 per cent, as a raw material for sulphuric acid manufacture.

All the larger chemical manure works in Britain continued to produce superphosphate, with increased output, during 1936. The new plant at Avonmouth has been erected for National Fertilisers, Ltd., for an output of at least 70,000 tons of superphosphate per year. This plant is of the "Oberphos" type and comprises three slowly rotating cylindrical autoclaves or digesters, which are lead-lined and steam-jacketted for maintaining the reaction temperature. The charge of finely-ground phosphate rock and sulphuric acid is automatically weighed and introduced into the autoclaves by special valves. Mixing, grinding, screening and bagging plant in the store for the finished superphosphate will handle 60 tons per hour. National Fertilisers, Ltd., is a combined interest of Fison, Packard and Prentice, Ltd., and the Imperial Smelting Corp., Ltd. The sulphuric acid is conveyed by pipe-line from the adjacent works of the National Smelting Co., Ltd.

The new Maxwell continuous mixing and excavating process for superphosphate manufacture has also excited interest during the past year and has shown some remarkable results in reducing manufacturing costs. Units are supplied for outputs of 5, 10 or 20 tons per hour. Synchronized feeding of acid and ground phosphate rock ensures the exact proportions which are necessary for the superphosphate reaction.

New plant erected at Bolsover, near Chesterfield, for Low Temperature Carbonisation, Ltd., will convert coal into smokeless fuel, coal oil and petrol. The first batteries of the present 288 retorts were lit at the middle of October; this section of the plant will convert 500 tons of coal per day. This plant is the fourth one to be erected by Low Temperature Carbonisation, Ltd. Their first plant has been working continuously, day and night, at Barugh, near Barnsley, since July 1927; the second, at Askern, near Doncaster, was started up in July 1929; and the third, built at the Greenwich works of the South Metropolitan Gas Co., London, has been operated under license since 1930. The four plants as a whole are capable of carbonising 1,600 tons of coal per day, with an output of 380,000 tons of smokeless fuel ("Coalite") and over 12,000,000 gallons of petrol and coal oil per year.

Following the success which attended a Czecho-slovakian installation, one of the largest tar distillation works in Britain, i.e. the Beckton works of the Gas, Light & Coke Co., near London, placed an order with the Kopper Coke Oven Co., of Sheffield, for the first Koppers pipe still to be erected in Britain. This installation will distil 400 gallons of raw tar per day for the production of light oil, carbolic oil, napthalene, benzol wash oil, anthracene oil, pitch of various softening points, and road tar of standard specification quality.

A new benzol recovery plant started up at the Glasgow Corporation Chemical Works in August is dealing with 14,000,000 cubic feet of coal gas per day and yields about 2½ gallons of benzol per ton of coal carbonized. The annual production of crude benzol from this plant will be about 600,000 gallons, part of which is to be utilised for dephenolating effluent from the ammonia plant which cause difficulties if passed direct to the sewage disposal works. The plant is notable for its centralized control house.

The byproduct plant at the coke ovens of the new iron and steel works of Stewarts & Lloyds Ltd., at Corby, has ammonia unit of the indirect recovery type where no liming of the ammonia liquor is required as ammonium chloride is obtained for use at the works; the benzol plant recovers crude spirit equal in quality to a "once run" product. The coke ovens have an output of 3,500 tons of coke per week. expensive plant reorganization has also taken place at the works of the Workington Iron & Steel Co., in order to lower the cost of manufacture. Here a portion of the gas, after removal of byproducts, is used for heating the ovens and for steam raising. A special continuous still, which forms part of the benzol plant, removes carbon disulphide from the unwashed benzol.

During 1936 the low temperature carbonisation industry has been steadily forging ahead with the object of obtaining petrol as well as smokeless fuel (which was once the main concern). The gas industry is also devoting more attention to the recovery of benzol, as evidenced by additional plant at many large gas works.

A. W. Daniels

E. D. Flynn

Lawrence W. Bass

PERSONALITIES

A. W. DANIELS, formerly vice-president in charge of sales of the American Manganese Steel Co., becomes the new head of the Universal Crusher Co., Cedar Rapids, Iowa. He will succeed W. L. Harrison, who has directed the progress of the Universal organization since 1912. In his new association, Mr. Daniels will have with him H. F. Rikhoff, formerly of the American Manganese Steel Co.

CALENDAR

LOUISIANA ENGINEERING SOCIETY, annual meeting, St. Charles Hotel, New Orleans, La., January 22 and 23.

TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY, annual meeting, Waldorf-Astoria Hotel, New York City, February 22-25.

FIRST INTERNATIONAL ELECTRODEPOSITION CONFERENCE, London, England, March 3 and 4.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Chapel Hill, N. C., April 12-15.

ELECTROCHEMICAL SOCIETY, seventy-first general meeting, Philadelphia, Pa., April 28 to May 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, Toronto, Canada, May.

E. D. FLYNN has been appointed chief engineer of Oliver United Filters, Inc. He will direct engineering work for both the Oakland, Calif., and Hazleton, Pa., factories. Since coming to the company in 1917, Mr. Flynn has been active in the field of filtration engineering, his work bringing him in contact with many of the process industries.

FRANK C. WHITMORE, dean of the school of chemistry and physics of Pennsylvania State College, has been elected president of the American Chemical Society for 1938. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, who has been president-elect for the past year, this month succeeds Edward Bartow of the University of Iowa. Three directors elected were Townes R. Leigh of the University of Florida, Robert E. Swain of Leland Stanford University, and Willard H. Dow, president of the Dow Chemical Co., Midland, Mich.

GEORGE W. SAWIN has been named vice-president and general manager of The B. F. Goodrich Rubber Co. of Canada, Ltd., Kitchener, Ont. This appointment fills the position left vacant by the recent death of Frank G. Morley. Mr. Sawin has a record of 24 years service with Goodrich, having joined the company immediately after graduating in engineering from the University of Delaware in 1912. Prior to his new appointment, he served as Philadelphia district manager.

LAWRENCE WADE BASS, who served as executive assistant at Mellon Institute of Industrial Research during the period 1929-31, has returned to that organization as assistant director after serving with the Borden Co., New York City, for six years, first as assistant director of research, then, since 1932, as director of research. Dr. Bass, who has previously distinguished himself by his researches in organic chemistry and biochemistry, has been devoting special attention to industrial research management and chemical economics. At the American Institute of Chemical Engineers' annual meeting at Baltimore this fall, he was elected a director for the year 1937.

JOHN WILCOX has given up his work with the Longview Fibre Co. to accept the position of assistant engineer with the St. Regis Kraft Co. in Tacoma, Wash. This company was formerly the Union Bag and Paper Power Corp. The Tacoma plant, which was closed in 1932, has been modernized since its purchase by St. Regis and has just commenced operation again.

VICTOR E. FLANAGAN has been appointed sales engineer for the Patterson Foundry & Machine Co. of East Liverpool, Ohio. He will be in charge of field work in pulverizing machinery and will specialize in ball and tube mills and closed-circuit grinding systems. For a number of years, Mr. Flanagan was connected with the mining machinery division of the Allis-Chalmers Mfg. Co.

Robert L. Taylor

ROBERT L. TAYLOR, who joined the Staff of *Chem. & Met.* in July, 1936, has been promoted to the position of assistant editor. Mr. Taylor is a native of Detroit, Mich., and is a graduate of the chemical engineering department of the University of Michigan, where he was editor of *The Michigan Technic.*

LEONARD C. CARTWRIGHT has recently joined the staff of Foster D. Snell, Inc., consulting chemists and chemical engineers, Brooklyn, N. Y. Mr. Cartwright was a member of the research staff of Skinner & Sherman, Inc., Boston, Mass., for three years, and then went to Venezuela as chemical engineer in charge of an experimental caustic soda plant. Since returning to the United States he has completed a special research program for Sterisol Ampoule Corp., Long Island City, N. Y., on the commercial production of solutions for intravenous injection.

CLARENCE J. WEST, editor of the *Institute of Paper Chemistry* and affiliated with Lawrence College, Appleton, Wisconsin, will be awarded the gold medal of the Technical Association of the Pulp and Paper Industry at the Association's annual meeting in New York, February 22-25. The award is being made to Dr. West for his bibliographical work in the pulp and paper fields.

R. J. MCNITT, consulting engineer of Perth Amboy, N. J., has spent a large part of his time in Italy during the past two years. Current Italian journals describe the recent visits of Mussolini to the large A.C.N.A. plant of Soc. Montecatini at Cesano Moderuo, mentioning in particular the plant for producing metallic sodium. This is the first and only one of its kind in Italy, and was designed and put into operation under the direction of Mr. McNitt.

HENRY W. ERICKSON has resigned recently from the Allis-Chalmers Mfg. Co. to become associated with Separations Engineering Corp., New York City, as vice-president and chief engineer.

C. A. BARNES and J. M. PILCHER have been appointed to the staff of Battelle Memorial Institute, Columbus, Ohio. Dr. Barnes has been assigned to the fuels division, and Mr. Barlow to the division of process metallurgy.

PAUL W. DALEY, RUSSELL E. JOHNSON, and O. WRAY, chemical engineering graduates from Massachusetts Institute of Technology, Iowa State College and Purdue University respectively, have joined the research division of Anderson-Prichard Oil Corp. at Chicago, Ill.

R. T. GOODWIN, former manager of the Shell Petroleum Co.'s fuel oil department in St. Louis, has been transferred to Shell's eastern affiliate, the Shell Union Oil Corp., New York City, where he will assume the duties of fuel oil manager. Dr. Goodwin has been associated with the petroleum industry for a number of years and has spent much of his time developing fuel oils for domestic, commercial and industrial uses. He came to the Shell Co. in 1932 from the Dorr Co. where he was in charge of sales in the petroleum division. He is a graduate of the University of Southern California and holds a doctor's degree in chemical engineering from Columbia University.

R. T. Goodwin

STUART M. FINCH has resigned his position as superintendent of Pacific Distillers, Inc. to establish his own plant for the manufacture of distilling equipment and special chemical equipment. The plant is located at Culver City, Calif. Last year Mr. Finch superintended the construction and operation of the new alcohol and commercial brandy plant of the John McClure Estate, Inc. at Selma, Calif.

BENJAMIN I. KAUFMAN, a recent graduate of the University of Indiana, has accepted a position as research chemist with the Continental Asbestos & Refining Corp., New York City.

ALONZO E. TAYLOR, internationally known as an authority on foodstuffs, has been appointed chairman of the research committee of General Mills, Inc., Minneapolis, Minn. Dr. Taylor will direct research and development work on the nutritional values of foods. In 1931 he served as the consulting expert attached to the American delegation to the International Wheat Conference in London.

E. M. ALLEN, formerly of the research and development laboratory of the Columbia Chemical Division of the Pittsburgh Plate Glass Co. at Barberton, Ohio, has joined the chemical staff of Wishnick-Tumpeer, Inc. While at Columbia he was responsible for the development of "Calcene," a calcium carbonate re-enforcing pigment used chiefly for rubber compounding.

OBITUARY

JULIUS STIEGLITZ, well known organic and physical chemist and retired head of the University of Chicago's department of chemistry, died Jan. 10 at the age of 69. Dr. Stieglitz was a former president of the American Chemical Society and was the recipient of the Willard Gibbs Medal in 1923.

HERBERT I. ALLEN, co-inventor of the Allen-Moore cell and treasurer of the Electron Chemical Co. of Portland, Me., died Jan. 11. Mr. Allen developed the use of the electrolytic cell in the paper and chlorine industries.

WILLIAM CAMPBELL, professor of metallurgy at Columbia University since 1914, was fatally stricken by a heart attack on Dec. 17. He was 60 years old. Professor Campbell was well known for his outstanding work in metallurgical fields, and he was a member of many scientific societies. He was the first Howe Professor of Metallurgy, a chair created in honor of the late Henry Martin Howe.

Chemical ECONOMICS

PRODUCTION of chemicals in November and December was reported to have been maintained at relatively high levels. Some of the important chemical-consuming industries, however, were affected by labor troubles and the new year opened with prospects that manufacturing activities in some lines would be curtailed and thus cause some drop in the volume of chemical consumption. This may be exemplified in the case of plate glass, production of which in November fell to 13,083,963 sq.ft. compared with 20,752,657 sq.ft. in the preceding month. The figures for December are not yet available but the output undoubtedly was small because of the closing of plants and the outlook for January is likewise unfavorable. Automotive production also has been hampered by labor difficulties either directly or through a shortage of parts or essential raw materials as a result of strikes at producing points.

In general, however, the chemical industry—both producing and consuming branches—closed the old year with a record of progress and entered the new year with prospects of reaching an all-time record for volume of output.

Marked gains in total net sales and a higher rate of collections on accounts receivable in November, 1936 as compared with November a year ago were reported by manufacturers in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce.

Total net sales of 539 manufacturers throughout the country registered an increase of over 16 per cent in November, 1936 from November, 1935. Without adjustment for seasonal influences, November, 1936 sales registered a decrease of over 9 per cent from October of this year.

Total sales increased in November over the same month last year for all of the 15 industry groups shown in the report. Percentages of increase for some of the groups were as follows: stone, clay and glass products, 44.7 per cent; iron and steel and products, 30.7 per cent; chemicals and allied products, 19.7 per cent; paper and allied products, 15.9 per cent; textiles, 12.2 per cent; petroleum products, 10.4 per cent; leather and products, 6.2 per cent; and rubber products, 4.6 per cent.

Freight car loadings for the first quarter of 1937 will be about 9.2 per cent above actual loadings during the first quarter of 1936, it has been estimated by the thirteen Shippers' Regional Advisory Boards. Loadings of twenty-nine principal commodities will be 5,307,026 cars during the present period, compared with 4,859,593 actual loadings for the commodities in the first quarter last year.

Each of the Regional Advisory Boards estimated a gain in loadings except those of the central Western and Northwest regions.

Increases are expected in twenty-three of the twenty-nine commodities used in the estimates. Decreases are estimated for grain, hay, straw and alfalfa, cotton seed and products except oil, fresh fruits other than citrus fruits, potatoes and live stock.

Among the prospective increases for the first quarter of this year are: salt, 2.8 per cent; petroleum and products, 5.6 per cent; lime and plaster, 13 per cent; fertilizers, 11.7 per cent; paper and prepared roofing, 9.8 per cent; and chemicals and explosives, 8 per cent.

Domestic consumption of crude rubber during November is estimated at 50,303 long tons, compared with 49,509 long tons for October, according to The Rubber Manufacturers Association. Consumption for November, 1935, was 42,310 (revised) long tons.

November reclaimed rubber consumption is estimated at 12,029 long tons, production 14,357 long tons, stocks on hand November 30, 28,135 long tons.

The 1937 foreign trade outlook for chemicals and related products is particularly good, according to the Department of Commerce. Aside from a few countries, economic conditions throughout the world are improving steadily, individual purchasing power is increasing, the consummation of international trade agreements is smoothing the rough spots in trade channels, and, perhaps, most significant of all are the gratifying trends that have been noted during the year just ended.

Foreign demand for American chemical products during 1936 continued the upward trend that has been noted each year since 1932, preliminary statistics show. The volume of such shipments during the period from 1933 to 1936 has increased approximately 50 per cent with all staple commodities sharing in the gain and a number of relatively new products such as plastics, synthetic resins, heating and refrigerating gases, and other, apparently firmly establishing themselves in the trade.

During the first ten months of 1936 the total value of our chemical export trade aggregated $128,000,000 compared with $111,600,000 in the corresponding months of the preceding year, and $85,600,000 for the first ten months of 1933.

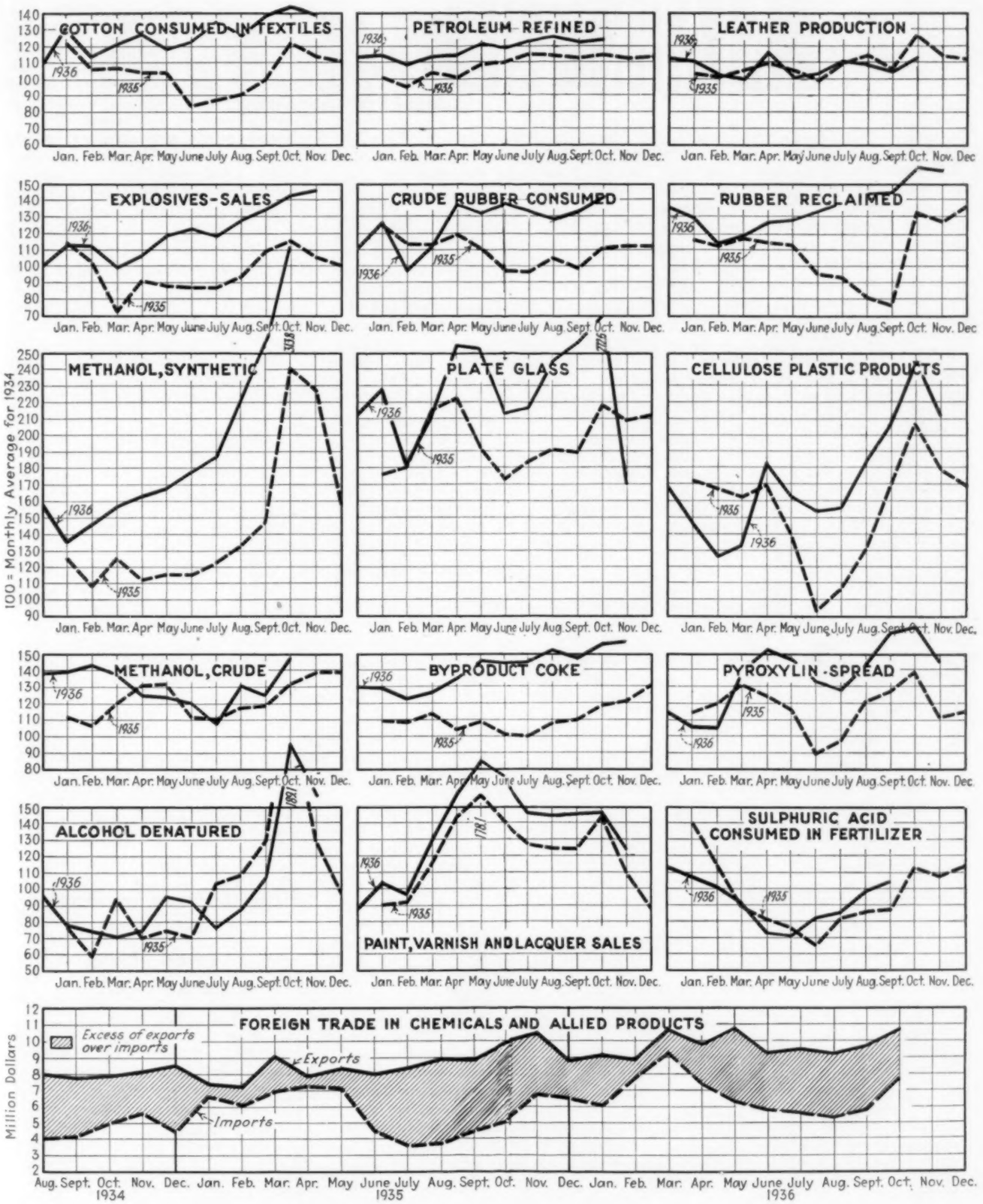
Export demand during the year was especially good for chemical specialties, paints and varnishes, medicinals, soaps and toilet preparations, and spectacular gains were recorded in shipments of sulphur and fertilizers.

Production and Consumption Data for Chemical Consuming Industries

	Nov. 1936	Nov. 1935	Jan.-Nov. 1936	Jan.-Nov. 1935	Gain Jan.-Nov. 1936 over Jan.-Nov. 1935 Per cent
Production					
Alcohol denatured, 1000 wi. gal...	12,584	10,297	87,823	89,555	2.0*
Ammonia, tons†	64,709	48,942	639,922	478,745	33.7
Automobiles, No.	394,890	395,059	3,955,814	3,542,406	11.1
Bensol, 1000 gal.	9,578	7,468	96,243	70,767	36.0
Byproduct coke, 1000 tons	4,048	3,116	40,156	30,905	29.9
Glass containers, 1000 gr.	3,880	3,275	41,183	35,700	15.4
Plate glass, 1000 sq. ft.	13,084	15,909	190,698	163,704	16.5
Methanol, crude, gal.	520,722	478,474	5,015,415	4,570,389	9.7
Methanol, synthetic, gal.	3,417,755	2,373,475	23,553,790	16,392,135	43.7
Rosin, wood, bbl.	58,023	47,214	603,786	506,268	19.3
Turpentine, wood, bbl.	8,866	7,474	95,236	77,435	23.0
Rubber reclaimed, tons	14,357	11,482	134,678	106,167	26.9
Steel barrels, No.	730,681	631,307	7,651,019	6,337,742	20.7
Consumption					
Cotton, 1000 bales	627	512	6,401	5,148	24.3
Silk, bales	40,401	37,012	413,013	461,584	10.5*
Explosives, sales, 1000 lb.	37,453	26,876	343,306	272,224	26.1
Paint, varnish and lacquer, sales, $1000	$28,503	$25,427	$353,092	$314,239	12.4

* Per cent of decline.
† Sulphate equivalent of byproduct coke plant production.

TRENDS OF PRODUCTION AND CONSUMPTION



The MARKETS

WITHDRAWALS against contracts have reached a total tonnage so far in the present month as to indicate that some branches of the chemical consuming industries are operating in an active way. The outlook, however, has become clouded because of the possibility that labor troubles will materially reduce consumption in such important lines as automotive and glass.

The chemical industry entered the new year with a generally firmer price trend. Competition remains keen but it has not taken on the form of price-cutting. The mineral acids have been strengthened by the reduction of stocks and by the fact that consumption has been keeping close to production. Alkalis are sold ahead in large volume and are expected to maintain a steady course. Solvents, which were under pressure throughout the last year, have worked into a better position and, with the exception of the labor situation, prospects are more favorable to higher than to lower prices. Naval stores likewise had an encouraging price movement and with production on a controlled basis, the market should not suffer from a preponderance of offerings.

Fertilizer tag sales in the southern states in November showed an increase of 16 per cent over those for November, 1935, and the increase in farm incomes is regarded as an indication that consumption of fertilizer chemicals in the present year will be considerably increased over the total for last year.

With the exception of paint-making oils, oils and animal fats took a strong upward turn in the last month. The shipping situation on the Pacific Coast has aided in this movement by curtailing arrivals of copra and coconut oil from the Far East. Other oils and fats, however, have moved up because of conditions which are by no means temporary and relatively high prices appear to be assured for some time to come, in spite of the fact that unusually large stocks of lard might be regarded as a bearish factor.

The Department of Commerce has issued a bulletin explaining the procedure to be followed by producers of naval stores in order to qualify for payments under the Naval Stores Conservation Program for 1937.

Civil strife in Spain has caused some disruption in the potash industry in that country. A report to the Department of Commerce stated that, after a period of idleness, the mines had resumed operations under the management of control committees set up by workers. The closing of the mines had little effect on world markets as the export quota of 14 per cent allotted to Spanish producers had been transferred to producers in other countries. On the other hand it was reported that shipments of potash had been made from Spain to other countries with the question of primary ownership in doubt.

Skyrocketing of domestic consumption of industrial drying oils by the paint and varnish industry in 1936, is indicated by figures recently made public. Tung oil consumption has jumped 70 per cent in the last four years and now closely approximates 127,600,000 lb. annually. Virtually all of this product comes from China, but two plantations on the Gulf Coast supplied about 2,000,000 lb. to the total consumed.

Domestic consumers used about 60,000,000 lb. of the perilla oil in the first three quarters of the current year, as compared with 27,573,000 lb. for the same period in 1935. Increased use by paint and varnish manufacturers of other drying oils, including, fish oils, 28,951,000 lb. and soybean oil, 13,003,000 lb. also is reported.

Among developments reported from abroad were: Manufacturers of molded products in Germany have issued a classified list of all synthetic molding compositions on the market belonging to the phenol and amino groups with the view to simplifying their buying problems. The list contains data on mechanical properties and heat resistance of various plastics offered on the German market and their reactions to certain chemicals, the report states.

Norway's nitrogen industry reports that price stability has been achieved through satisfactory operation of the international nitrogen cartel and that the adoption of rationalization measures has resulted in a reduction of operating expenses. One plant recently undertook the manufacture of dry ice as a side line and a new plant established for the manufacture of sodium nitrate from sea water is reported to be operating satisfactorily.

A sulphur company which has commenced operations in southern France plans to market its output in nearby regions to vineyards, reports from Paris indicate. The mine also produces an oil said to be suitable as a base for insecticides.

A Soviet Government Tung Oil Commission which visited the American tung belt during the latter part of 1936 contracted for 40 tons of seed nuts to be shipped to Soviet nurseries at Batum, in the Black Sea region. This brings Soviet purchases of American tung seed nuts during the past three years to approximately 66¾ tons, or sufficient it is estimated to plant in the neighborhood of 100,000 acres to tung trees.

Sales of iodine by the Nitrate and Iodine Sales Corporation of Chile, increased around 59 per cent to a total of 635 metric tons during the fiscal year, 1935-36, according to reports from Santiago. One new plant began production during the year, it was stated.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base = 100 for 1927

This month	87.26
Last month	86.67
January, 1936	87.21
January, 1935	87.53

The weighted index number is slightly higher than it was a year ago. Ammonium sulphate, zinc oxide, carbonate of lead, and bichromates were higher with practically no change in the position of mineral acids and alkalis. Solvents, including turpentine, were lower as were arsenic, formaldehyde, and some of the coal-tars.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base = 100 for 1927

This month	109.35
Last month	97.49
January, 1936	92.36
January, 1935	86.64

Practically all the oils and fats are higher in price than they were a year ago. Sharp advances are noted in cottonseed, coconut and palm oils. Animal oils and fats also are considerably above the price levels of last year and the same is true for glycerine. The index number advanced markedly during the last month.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to January 13.

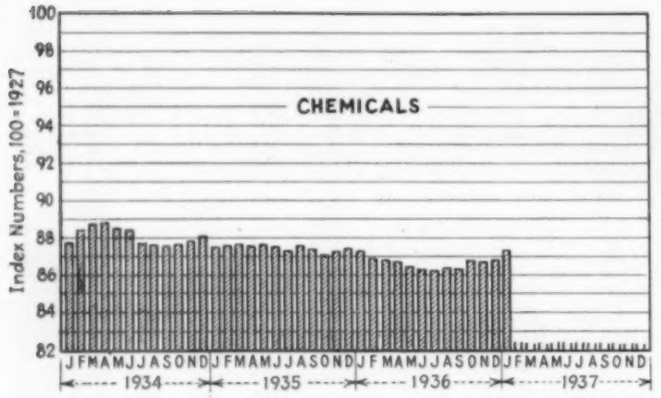
Industrial Chemicals

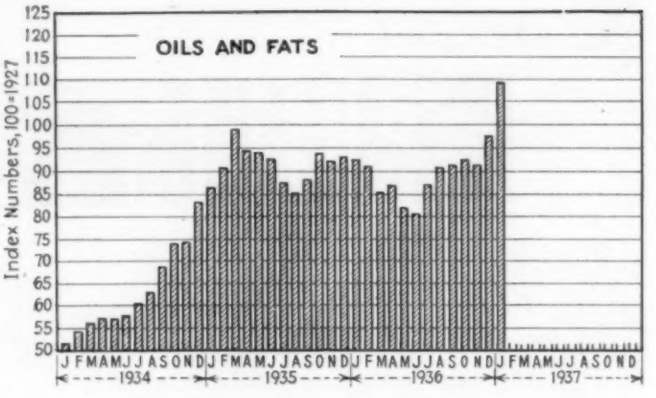
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.07 -$0.08	$0.07 -$0.08	$0.12-$0.12½
Acid, acetic, 28%, bbl., cwt.	2.45 - 2.70	2.45 - 2.70	2.45 - 2.70
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.52 -10.77	10.52 -10.77	10.52 -10.77
Boric, bbl., ton	105.00-115.00	105.00-115.00	105.00-115.00
Citric, kegs, lb	.25 - .28	.25 - .28	.28 - .31
Formic, bbl., ton	.11 - .11½	.11 - .11½	.11 - .11½
Gallic, tech., bbl., lb	.60 - .65	.60 - .65	.60 - .65
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06½- .06¾	.06½- .06¾	.12 - .12½
Muriatic, 18°, tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -20.00	18.50 -20.00
Oxalic, crystals, bbl., lb	.10½- .12	.11½- .12½	.11½- .12½
Phosphoric, tech., c'boys., lb.	.09 - .10	.09 - .10	.09 - .10
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb	.20 - .30	.20 - .30	.23 - .35
Tartaric, powd., bbl., lb	.22½- .23½	.24 - .25	.24 - .25
Tungstic, bbl., lb	1.50 - 1.60	1.50 - 1.60	1.50 - 1.60
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb	.123 -	.143 -	.15 -
Alcohol, Butyl, tanks, lb	.08½-	.08½-	.12 -
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.14 -	4.14 -	4.27½-
Denatured, 190 proof			
No. 1 special, dr., gal wks.	.32 -	.32 -	.33 -
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Potash, lump, bbl., lb	.05 - .04	.05 - .04	.03 - .04
Aluminum sulphate, com bags cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt.	2.00 - 2.25	2.00 - 2.25	1.90 - 2.00
Aqua ammonia, 26°, drums, lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .16	.15½- .16	.15½- .16
tanks, lb.	.04½-	.04½-	.04½-
Ammonium carbonate, powd. tech., casks, lb.	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt.	1.25 -	1.25 -	1.20 -
Amylacetate tech., tanks, lb.	.11 - .11½	.12 - .135	.142-
Antimony Oxide, bbl., lb.	.14 - .14½	.12½- .13½	.14 - .14½
Arsenic, white, powd., bbl., lb.	.03 - .03½	.03½- .04	.03½- .04
Red, powd., kegs, lb.	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	72.00 -74.00	72.00 -74.00	72.00 -74.00
Nitrate, cask, lb.	.08½- .09	.08½- .09	.08½- .09
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	44.00 -49.00	44.00 -49.00	44.00 -49.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.10 -	2.10 -	2.10 -
Arsenate, dr., lb.	.06 - .07	.06 - .07	.06 - .07
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton.	20.00 -33.00	20.00 -33.00	20.00 -33.00
flake, dr., del., ton.	22.00 -35.00	22.00 -35.00	22.00 -35.00
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05½- .06	.05½- .06	.05½- .06
Tetrachloride drums, lb	.05½- .08½	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb.	2.15 -	2.15 -	2.15 -
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.41 - 1.51	1.41 - 1.51	1.39 - 1.45
Copperas, bgs., f.o.b., wks., ton.	15.00 -16.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb	.11½- .16	.08½- .16	.11½- .16
Sulphate, bbl., cwt.	4.70 - 5.00	4.15 - 4.40	3.85 - 4.00
Cream of tartar, bbl., lb.	.15 - .15½	.16½- .17	.16½- .17
Diethylene glycol, dr., lb	.16½- .20½	.16½- .20½	.16½- .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	2.10 - 2.15
Ethyl acetate, drums, lb.	.07 -	.07 -	.08½-
Formaldehyde, 40%, bbl., lb.	.05½- .06½	.05½- .06½	.06 - .07
Furfural, dr., lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, ref. drums, lb.	.16 - .18	.16 - .18	.16 - .18
Glaubers salt, bags, cwt.	.85 - 1.00	.85 - 1.00	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.24½-	.21½-	.14 - .14½
Lead:			
White, basic carbonate, dry casks, lb.	.07½-	.06½-	.06½-
White, basic sulphate, sck., lb.	.06½-	.06½-	.06 -
Red, dry, sck, lb.	.085-	.077-	.07 -
Lead acetate, white crys., bbl., lb.	.11½- .12	.11 - .11½	.10½- .11
Lead arsenate, powd., bbl., lb.	.09½- .10	.09 - .10	.09 - .10
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk., lb.	.075-	.067-	.06 -
Lithophone, bags, lb.	.04½- .04¾	.04½- .04¾	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.33 -
97%, tanks, gal.	.34 -	.34 -	.34 -
Synthetic, tanks, gal.	.35½-	.35½-	.35½-
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb.	.11½-	.10½-	.10 -
Phosphorus, red, cases, lb.	.40 - .42	.40 - .42	.44 - .45
Yellow, cases, lb.	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.07½- .08½
Carbonate, 80–85%, calc. csk., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Chlorate, powd., lb	.08 - .08½	.08 - .08½	.08½- .09
Hydroxide (c'stic potash) dr., lb.	.07 - .07½	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton	23.00 -	23.00 -	22.00 -
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb.	.16 - .17	.18 - .19	.18 - .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -	1.23 -	1.23 -
Dense, bags, cwt.	1.25 -	1.25 -	1.25 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt.	1.75 - 2.00	1.75 - 2.00	1.85 - 2.00
Bichromate, casks, lb	.06½- .07	.06½- .07	.05½- .06½
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03 - .04
Chlorate, kegs, lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.75
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	2.15 - 3.15	2.15 - 3.15	3.25 - 3.40
Nitrate, bags, cwt.	1.375-	1.375-	1.275-
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.022- .023	.022- .023	.022- .024
Prussiate, yel. drums, lb.	.10 - .11	.10 - .11	.11½- .12
Silicate (40° dr.) wks., cwt.	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60–62%, dr., lb.	.02½- .03½	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.02½- .02½	.02½- .02½	.02½- .02½
Sulphur, crude at mine, bulk, ton.	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb.	.07 - .08	.06½- .08	.07 - .07½
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb.	.55 -	.52 -	.52 -
Crystals, bbl., lb.	.38 -	.38½-	.36½-
Zinc, chloride, gran., bbl., lb.	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb.	.09 - .11	.09 - .11	.09 - .11
Cyanide, dr., lb.	.36 - .38	.36 - .38	.36½- .38
Dust, bbl., lb.	.07 - .07	.068- .07	.06 - .07
Zinc oxide, lead free, bag., lb.	.05½-	.05½-	.056-
5% lead sulphate, bags, lb.	.05½-	.05½-	.04 -
Sulphate, bbl., cwt.	2.65 - 3.00	2.65 - 3.00	2.75 - 3.00

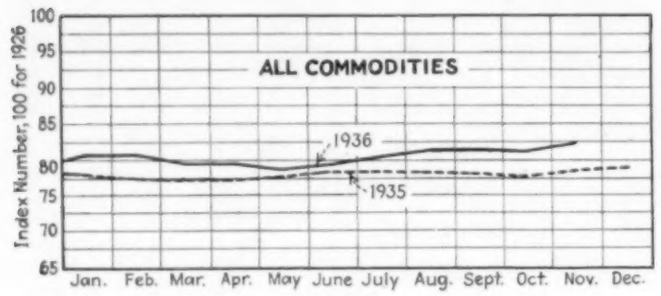
Oils and Fats

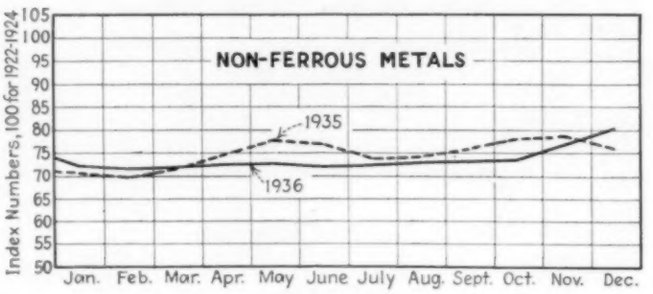
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½-$0.11	$0.10 -$0.11	$0.10 -$0.11
Chinawood oil, bbl., lb.	.15 -	.13½-	.14 -
Coconut oil, Ceylon, tanks, N. Y. lb.	.09½-	.07½-	.04½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.10½-	.09½-	.10 -
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.10½-	.10 -	.08½-
Linseed oil, raw car lots, bbl., lb.	.10½-	.092-	.10 -
Palm, casks, lb.	.06½-	.05½-	.04½-
Peanut oil, crude, tanks (mill), lb.	.10½-	.09½-	.09 -
Rapeseed oil, refined, bbl., gal.	.85 -	.75 -	.56 -
Soya bean, tank, lb.	.10 -	.08½-	.08 -
Sulphur (olive foots), bbl., lb.	.10½-	.09½-	.08½-
Cod, Newfoundland, bbl. gal.	.48 -	.48 -	.35 -
Menhaden, light pressed, bbl., lb.	.078-	.074-	.072-
Crude, tanks (f.o.b.factory), gal.	.35 -	.35 -	.36 -
Grease, yellow, loose, lb.	.08½-	.07½-	.05½-
Oleo stearine, lb.	.12 -	.09-	.09½-
Red oil, distilled, d.p. bbl., lb.	.10½-	.09½-	.09½-
Tallow ,extra, loose, lb.	.09½-	.07½-	.06½-

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-napthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Bensidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Bensoic acid, U.S.P., kgs., lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Bensol, 90%, tanks, works, gal.	.16 - .18	.16 - .18	.15 - .16
Beta-napthol, tech., drums, lb.	.23 - .24	.23 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.10 - .11	.10 - .11	.11 - .11½
Cresylic acid, 99%, dr., wks., gal.	.73 - .75	.73 - .75	.45 - .46
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl., lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil, 25%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.07½- .07½	.07½- .07½	.05½- .06
Nitrobensene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.45 - .47	.45 - .47	.51 - .55
Phenol, U.S.P., drums, lb.	.13½- .14	.13½- .14	.14½- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naptha, w.w., tanks, gal.	.26 -.....	.26 -.....	.26 -.....
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylene, com., tanks, gal.	.30 -.....	.30 -.....	.30 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grid., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.19½- .20½	.17½- .18	.15 - .16
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.37 - .38	.37 - .38	.36½- .37
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.75 - .80	.75 - .80	.80 - .85
Vermilion, English, bbl., lb.	1.69 - 1.72	1.69 - 1.72	1.58 - 1.60
Chrome yellow, C. P., bbl., lb.	.13 - .14	.13 - .14	.14 - .16
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.09 - .10	.09 - .10
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.13½- .16	.13½- .16	.15½- .16
Kauri No. 1 cases, lb.	.19 - .25	.19 - .25	.20 - .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton.	50.00 -.....	50.00 -.....	50.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	11.85 -.....	10.65 -.....	5.65 -.....
Turpentine, gal.	.49 -.....	.45½-.....	.50½-.....
Shellac, orange, fine, bags, lb.	.25 -.....	.25 -.....	.27 -.....
Bleached, bonedry, bags, lb.	.19½-.....	.17½-.....	.23½-.....
T. N. bags, lb.	.14 -.....	.13½-.....	.14½-.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

FREEPORT TEXAS CO., New York, has changed its name to Freeport Sulphur Co., formerly the name of its principal subsidiary.

STEARNS MAGNETIC MFG. CO., Milwaukee, has opened a sales office in the Architects Bldg., Philadelphia, with James Whiting in charge.

GENERAL ELECTRIC CO., Schenectady, N. Y., has elected five new commercial vice-presidents: M. O. Troy, Schenectady, manager of central station department; L. T. Blaisdell, Dallas, southwestern district manager; E. H. Ginn, Atlanta, southeastern district manager; A. L. Jones, Denver, Rocky Mountain district manager; and T. S. Knight, Boston, New England district manager.

AJAX FLEXIBLE COUPLING CO., Westfield, N. Y., has appointed George C. Ewing as New England sales representative with headquarters at 10 High St., Boston.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., as of Jan. 1 absorbed its subsidiary, Carbondale Machine Corp.

U. S. INDUSTRIAL ALCOHOL CO., New York, announces that on Jan. 1, Paul Harrison resigned as sales manager of the New York division of the company and as president of James A. Webb & Son. Mr. Harrison had been connected with the alcohol industry since 1890.

GENERAL REFRACTORIES CO., Philadelphia, has appointed H. R. Weller as district sales manager at Cleveland to succeed John C. Hopkins.

F. C. HUYCK & SONS, Albany, N. Y., has completed a talking motion picture film depicting every important step in the making of a Kenwood felt. The picture was shown for the first time at the Hotel Biltmore, New York, on Dec. 17.

CLIMAX MOLYBDENUM CO., New York, has moved its Detroit office and laboratory to 14410 Woodrow Wilson Ave.

FISH-SCHURMAN CORP., New York, has moved its offices and show rooms to larger quarters at 250 East 43d St.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1936	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	$137,000	$577,000	$1,607,000
Middle Atlantic	$6,117,000	578,000	20,177,000	15,348,000
South	.....	25,050,000	22,288,000	33,870,000
Middle West	1,040,000	2,487,000	17,969,000	11,734,000
West of Mississippi	1,105,000	1,000,000	11,105,000	11,473,000
Far West	.....	1,650,000	5,340,000	7,595,000
Canada	130,000	.....	15,875,000	9,624,000
Total	$8,392,000	$30,902,000	$93,331,000	$91,251,000

PROPOSED WORK

BIDS ASKED

Alcohol Plant—U. S. Industrial Alcohol Co., 60 East 42nd St., New York, N. Y., plans to construct an addition to its plant at Curtis Bay, Baltimore, Md. Estimated cost $37,000.

Chemical Factory—Valley Chemical Co., Saginaw, Mich., has purchased a site at Petrolia, Ont., Can., and plans to construct a branch factory.

Coke Ovens—Hanna Furnace Corp., Buffalo, N. Y., subsidiary of National Steel Corp., Detroit, Mich., plans to construct a battery of coke ovens at the Fuhrmann Drive plant, Buffalo. Estimated cost $6,000,000.

Distillery—Cedar Valley Distillery Co., Wooster, O., plans to construct a bottling plant, bonded warehouse, etc., at its plant. W. A. Neate, c/o Owner, Archt. Estimated cost will exceed $40,000.

Factory—Johnson & Johnson, Ltd., 2155 Pieth Ave., Montreal, Que., Can., plans to construct an addition to its factory and purchase new equipment. Perry & Luke, 1405 Bishop St., Montreal, Archts. Estimated cost $40,000.

Factory—Trenton Potteries Co., 309 North Clinton Ave., Trenton, N. J., plans to alter and construct a 1 story, 50x230 ft. addition to Plant No. 5. L. S. Kaplan, 33 West State St., Trenton, Archt.

Laboratory—Merck & Co., Lincoln Ave. and Pennsylvania R. R., Rahway, N. J., is having plans prepared by The Ballinger Co., Archt., 12th and Chestnut Sts., Philadelphia, Pa., for an addition to its laboratory.

Laboratory—University of Iowa, Iowa City, Ia., will soon award the contract for the construction of a botanical laboratory. George Horner, Grounds and Bldgs. Office, Archt. Estimated cost $65,000.

Oil Refinery—The Barnsdall Oil Corp., Petroleum Bldg., Tulsa, Okla., plans to construct an oil refinery along the ship channel in the vicinity of Corpus Christi, Tex. Estimated cost $1,000,000.

Radium Refinery—Eldorado Gold Mines, Ltd., 80 King St. W., Toronto, Ont., Can., plans to construct an addition to its plant and equipment at Port Hope, Ont., Can. Gilbert Labine, Genl. Mgr. Estimated cost $50,000.

Rubber Factory—Goodyear Tire & Rubber Co., Clifton Slosser, Vice Pres., Akron, O., plans to construct a factory for the manufacture of rubber tires at Jackson, Mich. Estimated cost will exceed $1,000,000.

Vinegar Plant—Gregory-Robinson-Speas, Inc., Paris, Tex., has purchased a five acre tract near Love Field Airport, Dallas, Tex., and contemplates the construction of a vinegar plant and distillery.

CONTRACTS AWARDED

Chemical Plant—Davidson Chemical Co., Curtis Bay, Baltimore, Md., has awarded the contract for improvements to its plant to Austin Co., Euclid Ave., Cleveland, O. Estimated cost $40,000.

Chemical Factory—Niacet Chemical Corp., Pine Ave. and 47th St., Niagara Falls, N. Y., has awarded the contract for the construction of an addition to its plant on Union St., to Wright & Kremers, Inc., Pine Ave. and Main St., Niagara Falls. Estimated cost including equipment $40,000.

Chemical Laboratory—Thomas & Hochwalt Laboratories, division of Monsanto Chemical Co., Dayton, O., has awarded the contract for the construction of a 1 to 3 story laboratory building on Nichols Rd., Dayton, O., to B. G. Davis Co., 1530 East First St., Dayton. Estimated cost $65,000.

Cotton Oil Plant—Southern Cotton Oil Co., c/o Oscar Robinson, Mgr., Harlingen, Tex., will construct a cotton oil plant along the tracks of the Southern Pacific Ry. near Harlingen. Work will be done by day labor under supervision of engineering branch of Company. Estimated cost $150,000.

Distillery—Nelson County Distillery, Inc., Bardstown, Ky., is building a distillery to include stills, warehouses, etc., at Greenbrier, Nelson Co., Ky. Work is being done by day labor and separate contracts. J. E. Conway and C. E. Keith, in charge. Estimated cost $150,000.

Factory—Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., has awarded the contract for rebuilding its factory at Pacific Ave. and New Jersey Central R. R., Jersey City, N. J., to Barney-Ahlers Construction Corp., 101 Park Ave., New York, N. Y. Estimated cost will exceed $200,000.

Factory—American Cynamid Co., 30 Rockefeller Plaza, New York, N. Y., has awarded the contract for the construction of a factory addition at Valdosta, Ga., to Fiske-Carter Construction Co., Spartanburg, S. C. Estimated cost $600,000.

Factory—R. & H. Chemical Dept., E. I. du Pont de Nemours & Co., Niagara Falls, N. Y., has awarded the contract for a factory on Buffalo Ave., to Laur & Mack Contg. Co., 1400 College Ave., Niagara Falls, N. Y.

Factory—Sterling China Co., Wellsville O., has awarded the contract for an addition to its factory to D. F. Nellis & Sons Co., East Liverpool, O. Estimated cost $43,000.

Factory—Union Carbide & Carbon Research Laboratories, 47th St., Niagara Falls, N. Y., have awarded the contract for the construction of a factory to Scrufari Construction C., 825 15th St., Niagara Falls, N. Y.

Gasoline Plant—Southern Mineral Corp., Corpus Christi, Tex., will construct an absorption gasoline plant near Corpus Christi, Tex., to have a daily capacity of approximately 25,000,000 cu. ft. Work will be done by day labor and separate contracts.

Glass Factory—Pittsburgh Plate Glass Co., 4 Chester Ave., Newark, N. J., has awarded the contract for the construction of a factory to Frank Briscoe Co., Inc., 287 South 19th St., Newark. Estimated cost $106,000.

Glycerin Factory—Lever Bros. Co., 164 Bway., Cambridge, Mass., has awarded the contract for rebuilding its glycerin factory to Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass. Estimated cost will exceed $37,000.

Laboratory—New York State Department of Education, State Education Bldg., Albany, N. Y., has awarded the general contract for laboratory and administration building to Amsterdam Building Co., 480 Lexington Ave., New York, N. Y., $112,370.

Paint Factory—Elliott Paint & Varnish Co., 4522 West 5th Ave., Chicago, Ill., has awarded the contract for the construction of a factory to Campbell-Lowrie-Lautermilch Co., 400 West Madison St., Chicago, Ill. Estimated cost $40,000.

Varnish Factory—Pontiac Varnish Co., Pontiac, Mich., has awarded the contract for the construction of a factory to H. S. Smith, Pontiac, Mich. Estimated cost $45,000.

Pulp Mill—Chesapeake Camp Corp., Franklin, Va., has awarded the contract for the construction of a pulp mill to Rust Engineering Co., Clark Bldg., Pittsburgh, Pa. Estimated cost $3,500,000.

Paper Mill—Container Corporation of America, 111 West Washington St., Chicago, Ill., has awarded the contract for the first unit of new pulp and paper mill at Fernandina, Fla., to Merritt Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $3,000,000; total estimate $7,000,000.

Paper Mill—Fort Wayne Corrugated Paper Co., Connellsville, Pa., has awarded the contract for a 70x340 ft. addition to its mill to Austin Co., 19 Rector St., New York, N. Y.

Plywood Plant—Harbor Plywood Corp., Port of Grays Harbor, Aberdeen, Wash., has awarded the contract for the construction of an addition to its plant to J. B. Lamb, 1319 Belaire S., Aberdeen. Estimated cost $150,000.

Paper Mill—Southern Kraft Corp., subsidiary of International Paper Co., 220 East 42nd St., New York, N. Y., will construct a paper mill at Georgetown, S. C. Owner will build with own forces. Excavation under way. Total estimated cost will exceed $8,000,000.

Pulp and Paper Mill—St. Joe Paper Co., Port St. Joe, Fla., organized by Almours Securities Inc., Barnett Bldg., Jacksonville, Fla., awarded contract for kraft pulp and paper mill to James Stewart & Co., Inc., 230 Park Ave., New York, N. Y. Estimated cost $6,800,000.

Pulp Mill—Union Bag & Paper Corp., Savannah, Ga., has awarded the contract for the third unit of its kraft pulp and paper mill to Merritt, Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $3,000,000.

Refinery—Pan-American Refining Corp., 122 East 42nd St., New York, N. Y., has awarded the contract for the construction of a cracking plant at Texas City, Tex., to M. W. Kellogg Co., 225 Bway., New York, N. Y. Estimated cost $260,000.

Refinery—Talco Pipe Line Co., Continental Bldg., Dallas, Tex., has awarded the contract for the construction of a cracking plant at Mt. Pleasant, Tex., to Frick-Reid Supply Corp., Magnolia Bldg., Dallas; 50-car steel loading rack to Mosher Steel & Machinery Co., 5101 Maple Ave., Dallas. Estimated cost $550,000.

Refinery—Tide Water Associated Oil Co., Avon, Calif., has awarded the contract for a cracking unit and refinery improvements to Alco Products, Inc., 30 Church St., New York, N. Y. Estimated cost $1,500,000.

Research Laboratory—Abbott Laboratories, North Chicago, Ill., have awarded the contract for a research laboatory at 14th St. and Sheridan Rd., North Chicago, to W. E. O'Neil Construction Co., 1751 Clyourn St., Chicago. Estimated cost $40,000.

Research Laboratory—Batelle Memorial Institute, 505 King St., Columbus, O., has awarded the contract for a research laboratory to George Riebel, 1782 Franklin Ave., Columbus, O. Estimated cost $180,000.

Rubber Factory—Armstrong Rubber Co., 475 Elm St., New Haven, Conn., has awarded the contract for the construction of a factory to E. & F. Construction Co., 94 Wells St., Bridgeport. Estimated cost $100,000.

Rubber Factory—Firestone Tire & Rubber Co., Akron, O., has awarded the contract for improvements to its factory at Memphis, Tenn., to S. & W. Construction Co., Shrine Bldg., Memphis, Tenn.

Sugar Refinery—Corn Products Refining Co., 333 North Michigan Ave., Chicago, Ill., and 17 Battery Pl., New York, N. Y., will construct a corn sugar refinery at Pekin, Ill. Work will be done by day labor and separate contracts. Estimated cost $2,000,000.

Technical Societies and Trade Assns.

AIR CONDITIONING Mfrs.' Assn. Exec. Vice-Pres., William B. Henderson, 915 Southern Bldg., Washington, D. C.

Aluminum Research Institute. R. D. T. Hollowell, 308 W. Washington St., Chicago, Ill.

Amer. Assn. for the Advancement of Science. Perm. Sec., Henry B. Ward, Smithsonian Inst. Bldg., Washington, D. C.

Amer. Assn. of Cereal Chemists. Treas., M. D. Mize, c/o Wallace & Tiernan Co., Inc., 11 Mill St., Belleville, N. J.

Amer. Assn. of Engrs. Sec., M. E. McIver, 8 S. Michigan Blvd., Chicago, Ill.

Amer. Assn. of Textile Chemists & Colorists. Sec., Dr. H. C. Chapin, c/o Lowell Textile Institute, Lowell, Mass.

Amer. Bakers' Assn. Pres., Henry Stude; Sec., Tom Smith, 1135 Fullerton Ave., Chicago, Ill.

Amer. Bureau of Metal Statistics. Dir., W. R. Ingalls, 33 Rector St., New York.

Amer. Ceramic Society. Gen. Sec., Ross C. Purdy, 2525 N. High St., Columbus, Ohio.

Amer. Chemical Society. Sec., Dr. Charles L. Parsons, Mills Bldg., Washington, D. C.

Amer. Concrete Institute. Sec., Harvey Whipple, 642 New Center Bldg., Detroit, Mich.

Amer. Drug Mfrs.' Assn. Exec. Vice-Pres.-Sec., Carson P. Frailey, 506 Albee Bldg., Washington, D. C.

Amer. Electro-Platers' Society. Sec.-Treas., Wm. J. R. Kennedy, 90 Maynard St., Springfield, Mass.

Amer. Foundrymen's Assn. Exec. Sec.-Treas., C. E. Hoyt, 222 W. Adams St., Chicago, Ill.

Amer. Gas Assn. Man. Dir., Alexander Forward, 420 Lexington Ave., New York.

Amer. Institute Laundry. Drawer 1187, Joliet, Ill.

Amer. Institute of Chemical Engrs. Sec.-Exec. Sec., F. J. LeMaistre, Bellevue Court Bldg., Philadelphia, Pa.

Amer. Institute of Chemists. Sec., Howard S. Neiman, 2110 Woolworth Bldg., New York.

Amer. Institute of Consulting Engrs. Sec.-Treas., Philip W. Henry, 75 West St., New York.

Amer. Institute of Electrical Engrs. Nat. Sec., H. H. Henline, 33 W. 39th St., New York.

Amer. Institute of Mining & Metallurgical Engrs. Sec., A. B. Parsons, 29 W. 39th St., New York.

Amer. Institute of Refrigeration. Gen. Sec., J. F. Nickerson, 433 N. Waller Ave., Chicago, Ill.

Amer. Lampblack Mfrs.' Assn. Pres., March G. Bennett, 141 Milk St., Boston, Mass.

Amer. Leather Chemists Assn. Sec., C. A. Blair, 279 Mulberry St., Newark, N. J.

Amer. Management Assn. Pres., Alvin E. Dodd, 330 West 42d St., New York.

Amer. Manganese Products' Assn. Pres., J. Carson Adkerson, National Press Bldg., Washington, D. C.

Amer. Museum of Safety. Exec. Vice-Pres.-Dir., Albert A. Hopkins, 60 East 42d St., New York.

Amer. Oil Chemists' Society. Sec., J. C. P. Helm, 500 Tchoupitoulas St., New Orleans.

Amer. Paper & Pulp Assn. Sec., Charles W. Boyce, 122 E. 42d St., New York.

Amer. Petroleum Institute. Pres., Axtell J. Byles; Exec. Vice-Pres., W. R. Boyd, Jr.; Sec., Lacey Walker, 50 W. 5th St., New York.

Amer. Pharmaceutical Mfrs.' Assn. Sec., C. W. Warner, 250 High St., Newark, N. J.

Amer. Photo-Engravers' Assn. Louis Flader, 166 W. Van Buren St., Chicago, Ill.

Amer. Physical Society. Sec., W. L. Severinghaus, Columbia Univ., New York.

Amer. Pulp & Paper Mill Superintendents' Assn., Inc. Sec., R. L. Eminger, 54 N. Main St., Miamisburg, Ohio.

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Large Increase in World Production of Arsenic

DEFINITE totals for production of arsenic in the various producing countries of the world are not available for as late as 1935 but increased mining operations in recent years is admitted to have resulted in a larger output of this commodity. For example, production of Sweden was reported at 4,350 tons in 1930 and 28,618 tons in 1934. Western Australia had an output of 416 tons in 1931 and 1,657 tons in 1934. Brazil offered a supply of 179 tons in 1931 and 696 tons in 1935. The Canadian output dropped to 666 tons in 1933 and increased to 1,161 tons in 1935. The report on France credits a production of 4,970 tons in 1930 and 7,010 tons in 1934. Japan is rated at 1,654 tons in 1930 and 2,734 tons in 1934. Mexico had dropped its output to 3,991 tons in 1932 with 9,950 tons for 1935. Turkey was a minor producer in 1931 with a 22 ton total, whereas in 1934 its total was 6,596 tons.

Figures for domestic production of crude actually represent total production as the totals for refined represent the amounts produced from the crude.

Imports of arsenic in October 1936 amounted to 767 short tons with countries of origin as follows: Canada 43 tons; Mexico 25 tons; Belgium 39 tons; Germany 1 ton; Sweden 535 tons; Japan 124 tons. For the first 10 months of 1936 imports were 14,922 tons compared with 12,606 tons for the comparable period of 1935.

In 1935 the four domestic producers of white arsenic turned out 14,237 tons as compared with 13,096 tons in 1934. In commenting on this a report from the Bureau of Mines said that although in recent years the trend of production and sales of white arsenic had been away from refined arsenic and toward the crude product, production of refined rose to 6,654 short tons in 1935, approaching that of crude, which declined somewhat to 7,583 short tons. Of the total sales of white arsenic, 12,670 short tons, 55 per cent was sold as crude and the remainder as refined. In 1934, however, more than two-thirds of domestic sales of white arsenic were in the form of the crude product—production amounting to 13,096 short tons and sales of crude amounting to 8,997 short tons.

In a report, issued by the Bureau of Mines, domestic sales of white arsenic were allocated as follows: insecticides, 70 per cent; weed killers, 16 per cent; glass, 6 per cent; wood preservatives, 2 per cent; and exports, 6 per cent.

Changes in the distribution of white arsenic are shown by the fact that for 1934 sales by industries were allocated as follows: insecticides, 69 per cent; weed killer and fungicides, 9 per cent; glass, 3 per cent; wood preservative, 1 per cent; and exports, 18 per cent.

Arsenic Research in Sweden

In Sweden, according to the report, the disposal of enormous stocks of arsenic, said to amount to 200,000 metric tons, is still a major problem. Annual production is probably 40,000 to 50,000 tons. An experimental laboratory has been established in Stockholm to work out new uses for arsenic in the control of plant diseases and in the impregnation of timber and concrete, and a larger refining plant has been built. Various concrete mixtures appear to offer the most promising means for disposing of large quantities of arsenic. The Boliden Mining Co. has developed an "arsenic concrete" which is said to be especially suitable for protecting piles and other wooden structures exposed to the action of sea water.

In a canal inside the Sote Fiord, Sweden, opened for traffic in July 1935, piles and other timbers are used that have been sprayed with this "arsenic concrete." The arsenic, cement, and sand were mixed in the proportion of 1:3:12. The admixture of arsenic helps the cement to adhere to the wood and makes the mixture sufficiently elastic to prevent the cement coating from spalling off.

Arsenic in Cement

The Boliden Mining Co. also has patented a new type of hydraulic cement with aluminum arsenate as the principal constituent; lime or lime-bearing substances and silica also are present. By hydration of the cement, the aluminum arsenate reacts with the lime, forming insoluble calcium arsenate which improves the resistance to disintegration of the hardened concrete. The aluminum arsenate also can be added to portland cement or fused aluminate cement; it is produced by oxidation of arsenic trioxide mixed with bauxite or other material containing aluminum.

The report adds that arsenic may gain in importance as a wood preservative as is indicated by the appearance of an arsenic-copper combination developed in British India and patented in other countries. The product, known as Ascu, is said to be suitable for injection into wood in steel-pressure cylinders—as it does not corrode steel, iron, or brass—and to be as effective as creosote in its wood-preserving qualities.

Imports of White Arsenic By Countries

Country	1932 Short tons	1932 Value	1933 Short tons	1933 Value	1934 Short tons	1934 Value	1935 Short tons	1935 Value
Australia	6	$380	452	$23,001	39	$1,494	56	$2,334
Belgium	278	18,698	239	13,760	11	705	129	4,450
Canada	841	60,462	457	31,404	672	44,710	1,068	65,540
France	537	16,194	3,810	113,606	3,338	94,859	2,354	65,609
Germany	252	15,927	219	12,482	35	3,845	10	906
Japan	1,643	63,659	1,337	60,397	1,311	61,126	1,059	42,866
Mexico	3,325	182,671	4,041	256,611	8,704	500,970	9,274	525,140
Netherlands	.....	.....	.....	.....	.....	.....	.....	.....
Sweden	.....	.....	28	1,281	.....	.....	1,125	30,524
Totals	6,882	$357,991	10,583	$512,542	14,110	$707,709	15,075	$737,369

Domestic Production of Arsenic—Crude and Refined

	Crude: Production Short tons	Crude: Deliveries to Refiners Short tons	Crude: Deliveries to Consumers Short tons	Crude: Stock at end of period Short tons	Refined: Production Short tons	Refined: Stocks at end of period
1930	21,165	16,175	2,997	5,767	12,889	2,221
1931	21,067	18,425	2,293	6,116	14,482	4,295
1932	15,860	14,645	1,535	5,796	10,489	5,107
1933	11,189	10,522	2,080	4,788	8,185	3,851
1934	13,720	8,950	6,494	3,064	6,568	1,192
1935	17,380	14,521	2,699	3,224	10,681	2,318
1936:						
January	1,782	1,597	77	3,332	950	2,296
February	1,262	916	426	3,252	632	2,205
March	2,160	1,186	595	3,631	728	1,873
April	1,404	1,449	323	3,263	716	1,639
May	1,667	1,165	385	3,380	855	1,385
June	1,776	1,141	652	3,363	663	979
July	2,444	1,303	821	3,683	1,085	897
August	1,975	1,217	480	3,961	847	1,014
September	1,502	1,137	182	4,144	808	867
October	1,853	1,430	141	4,426	782	790
November	1,796	1,137	238	4,847	692	983
1936 totals	19,621	13,678	4,320		8,758	